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EDITED BY THURSTON SCOTT WELTON, M.D., F.A.C.S.

June 1941

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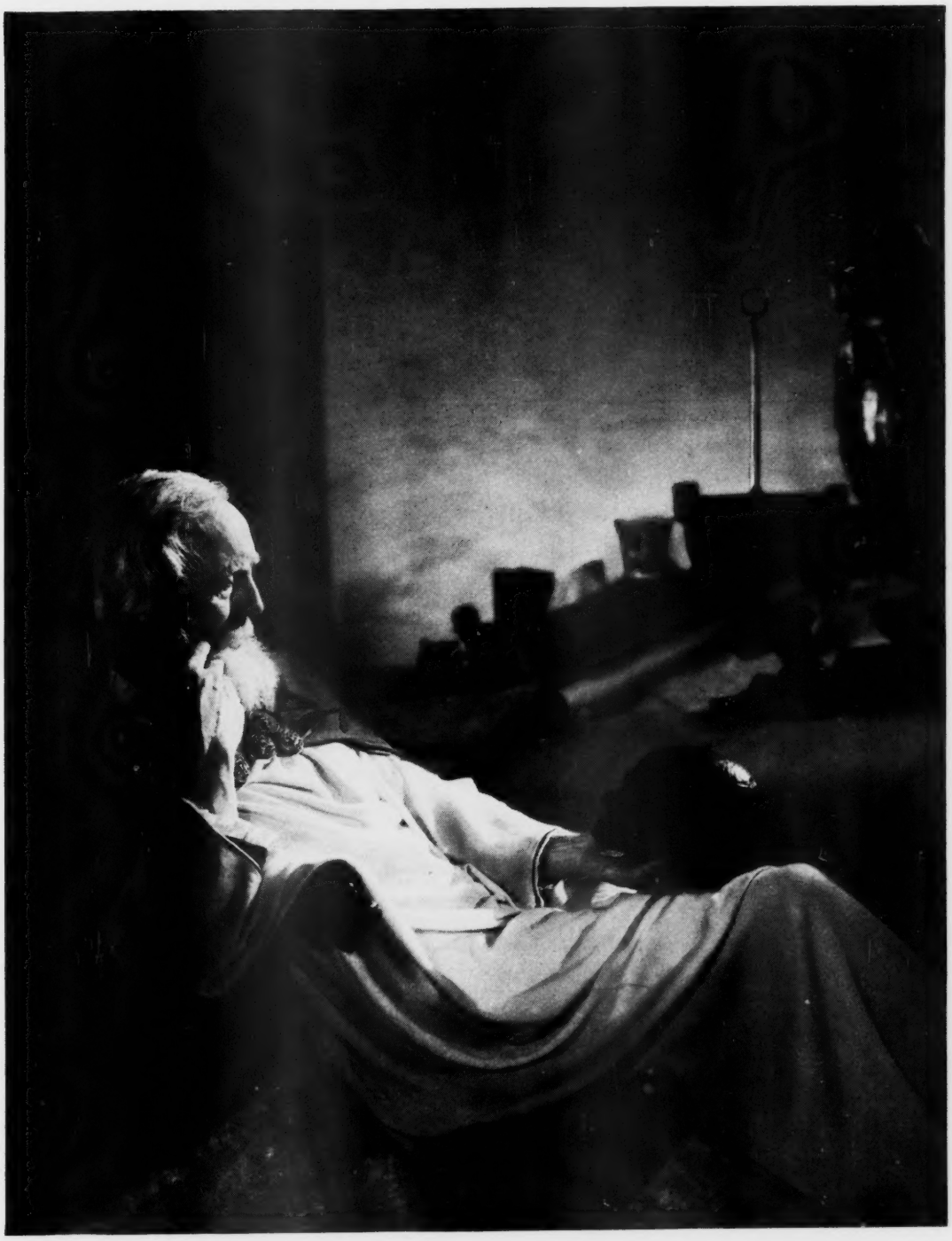

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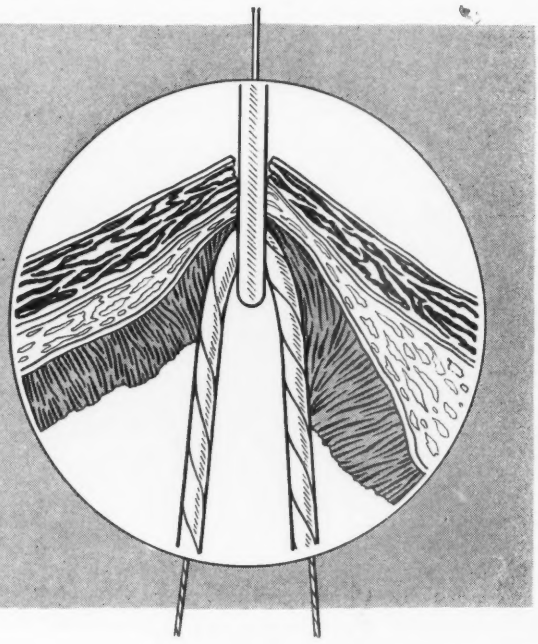

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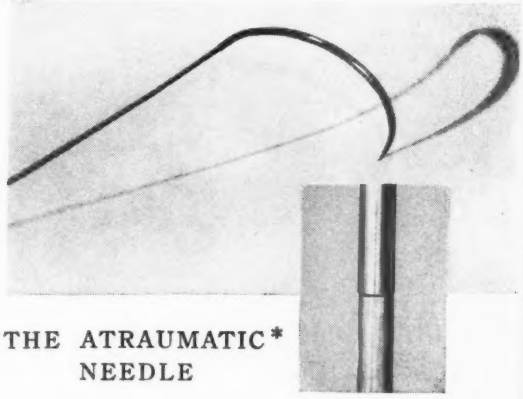

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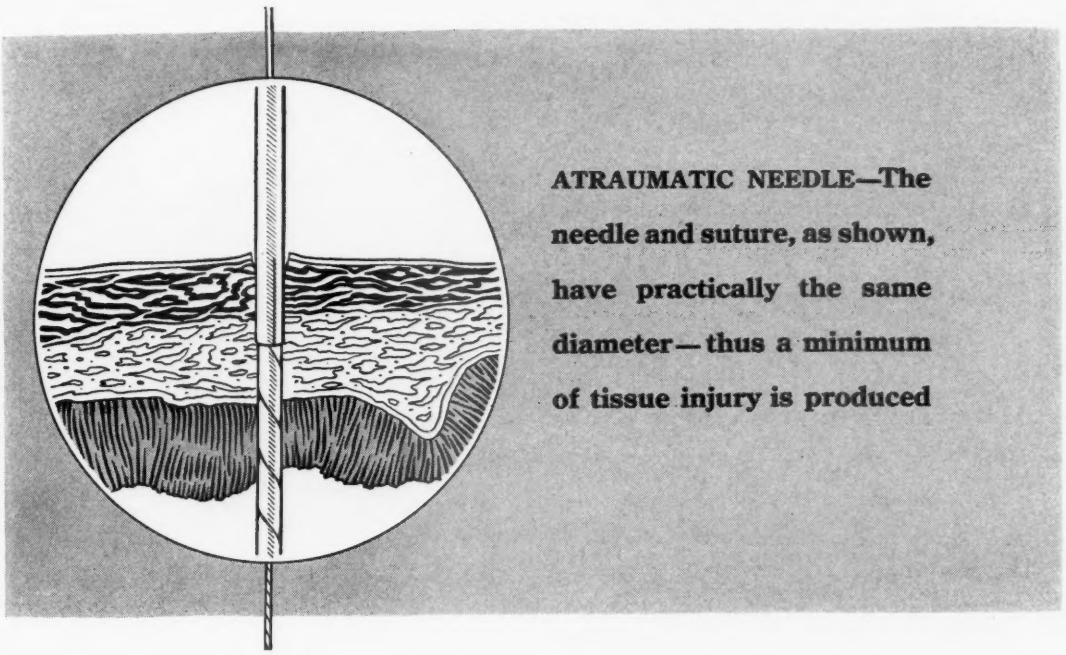

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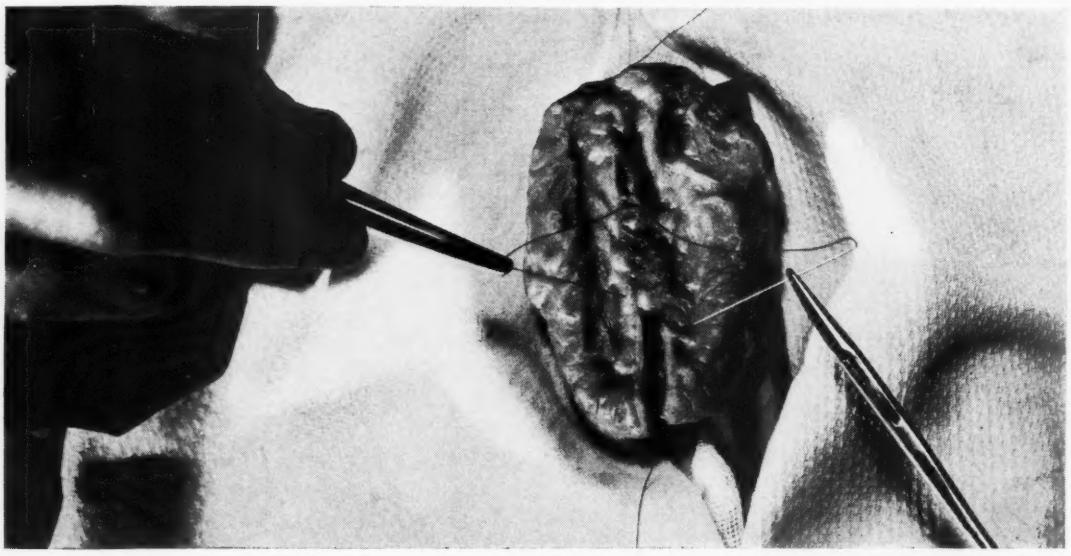

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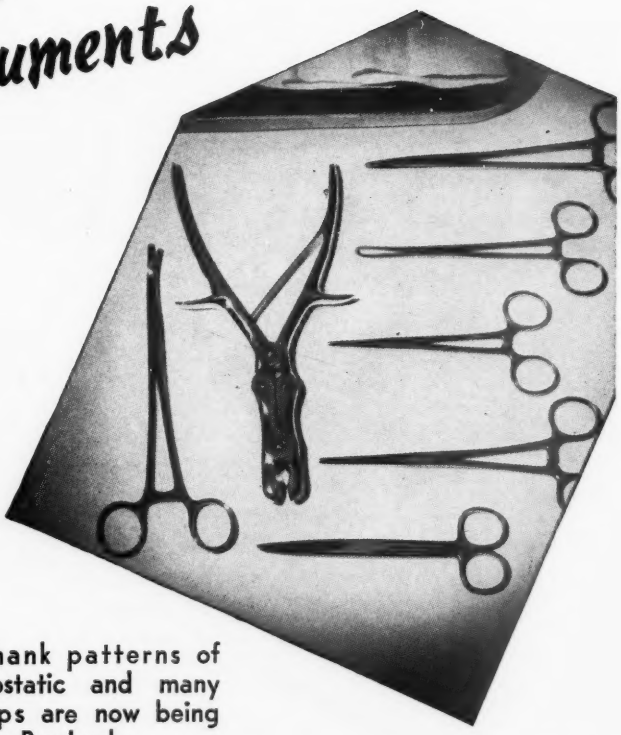

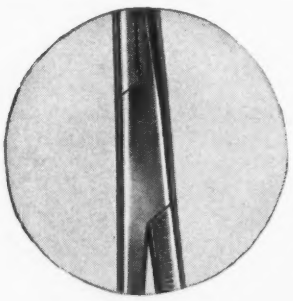

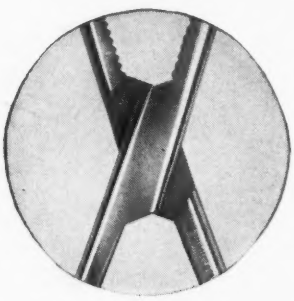

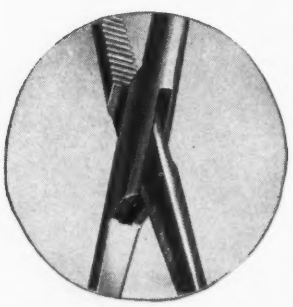

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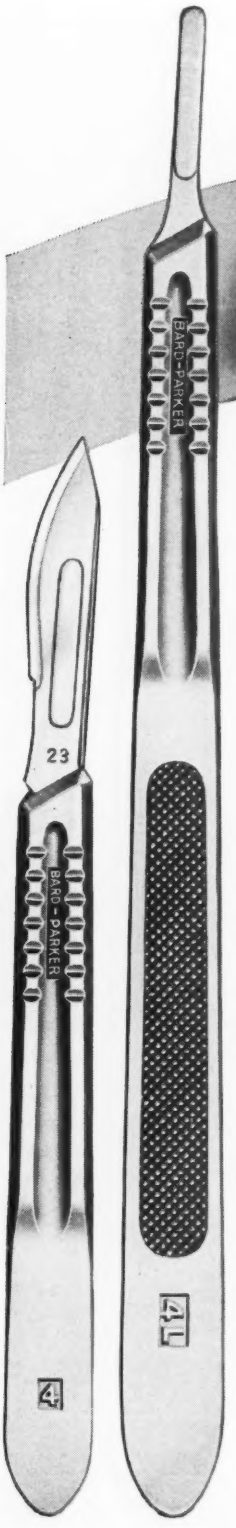

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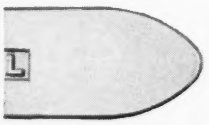

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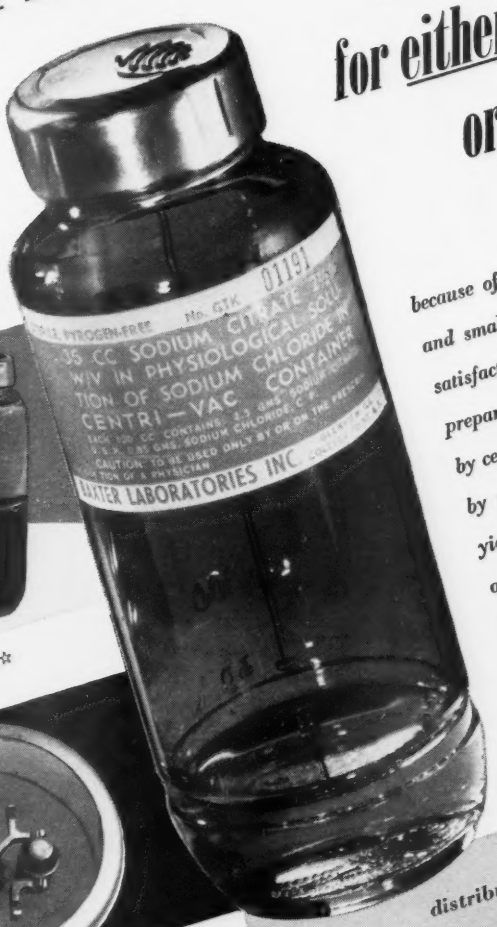
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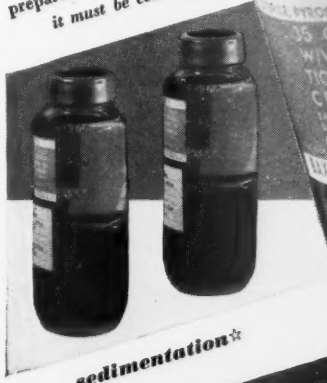

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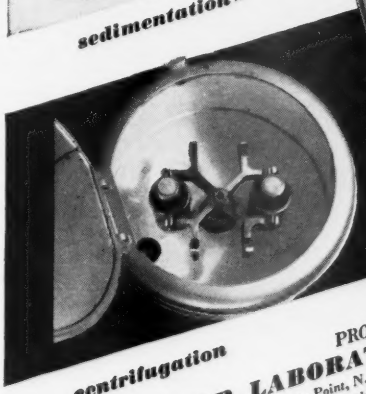

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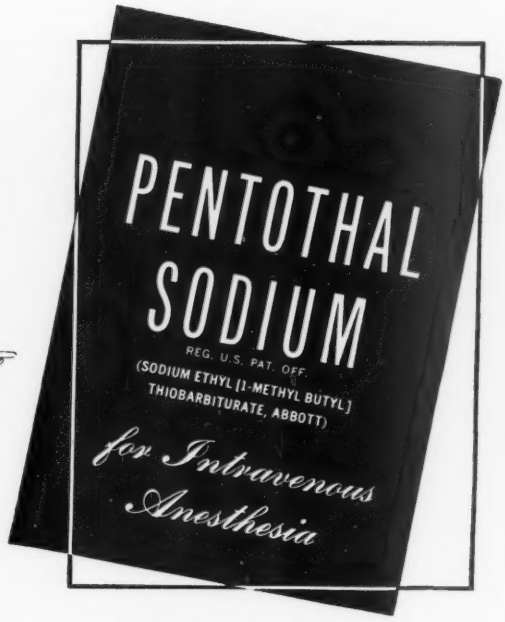

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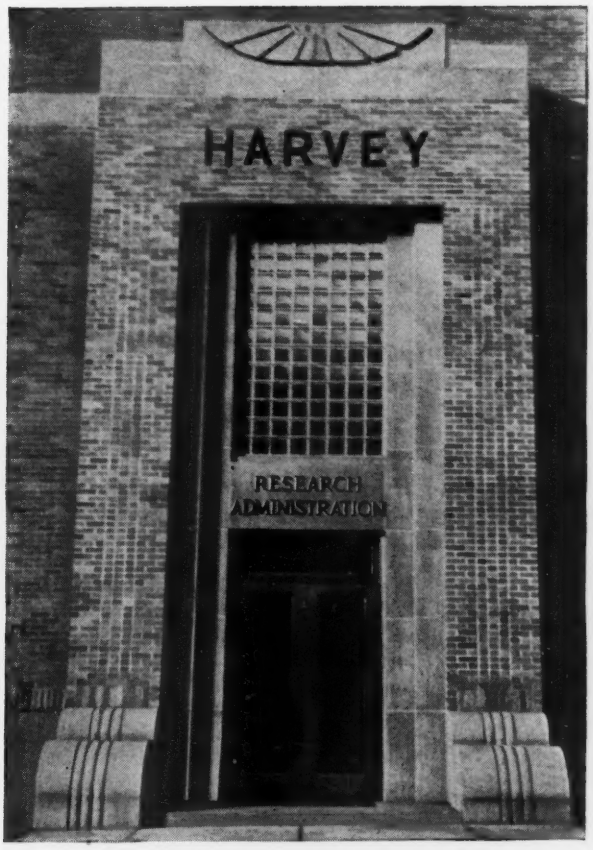

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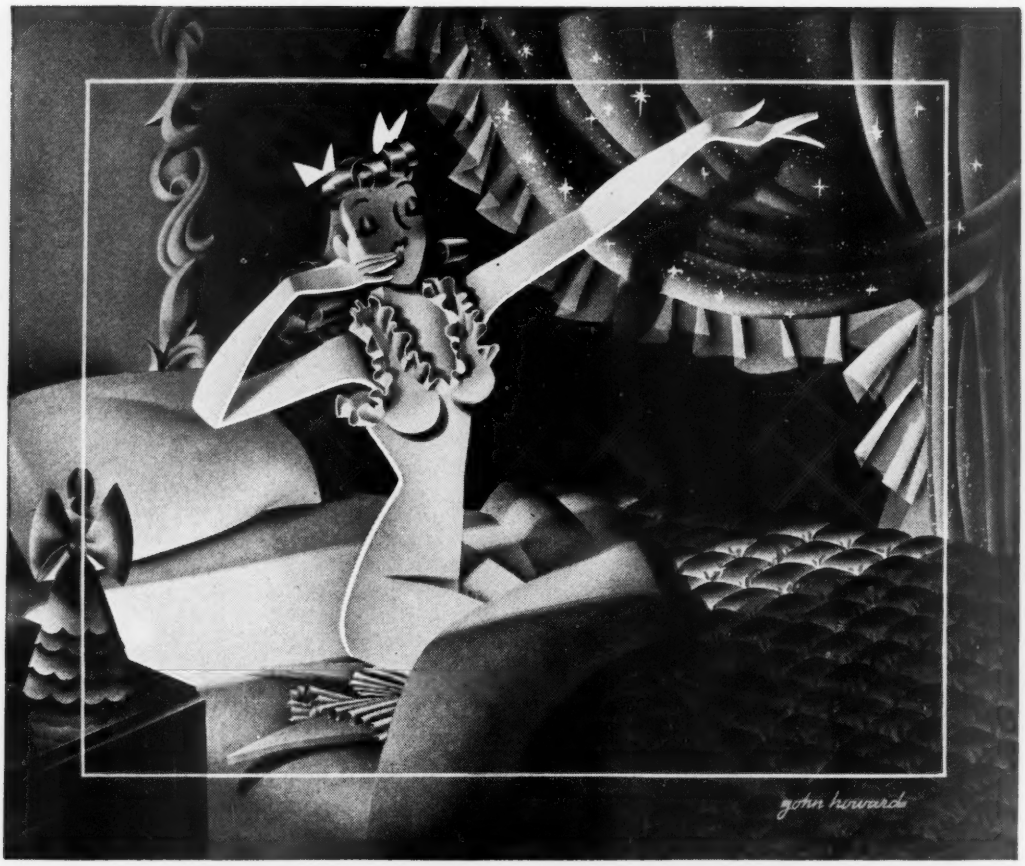

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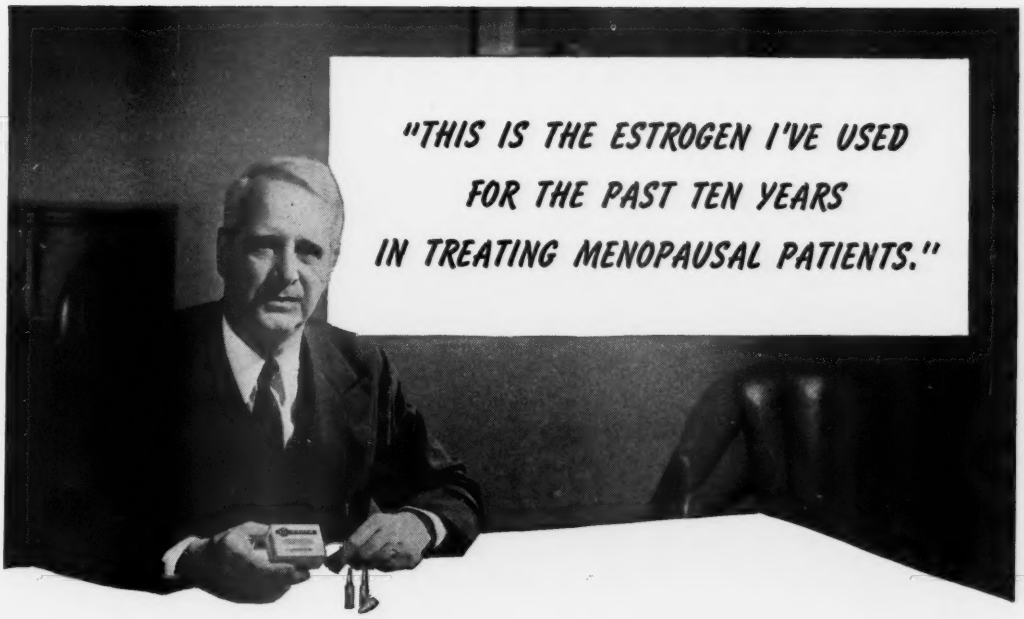

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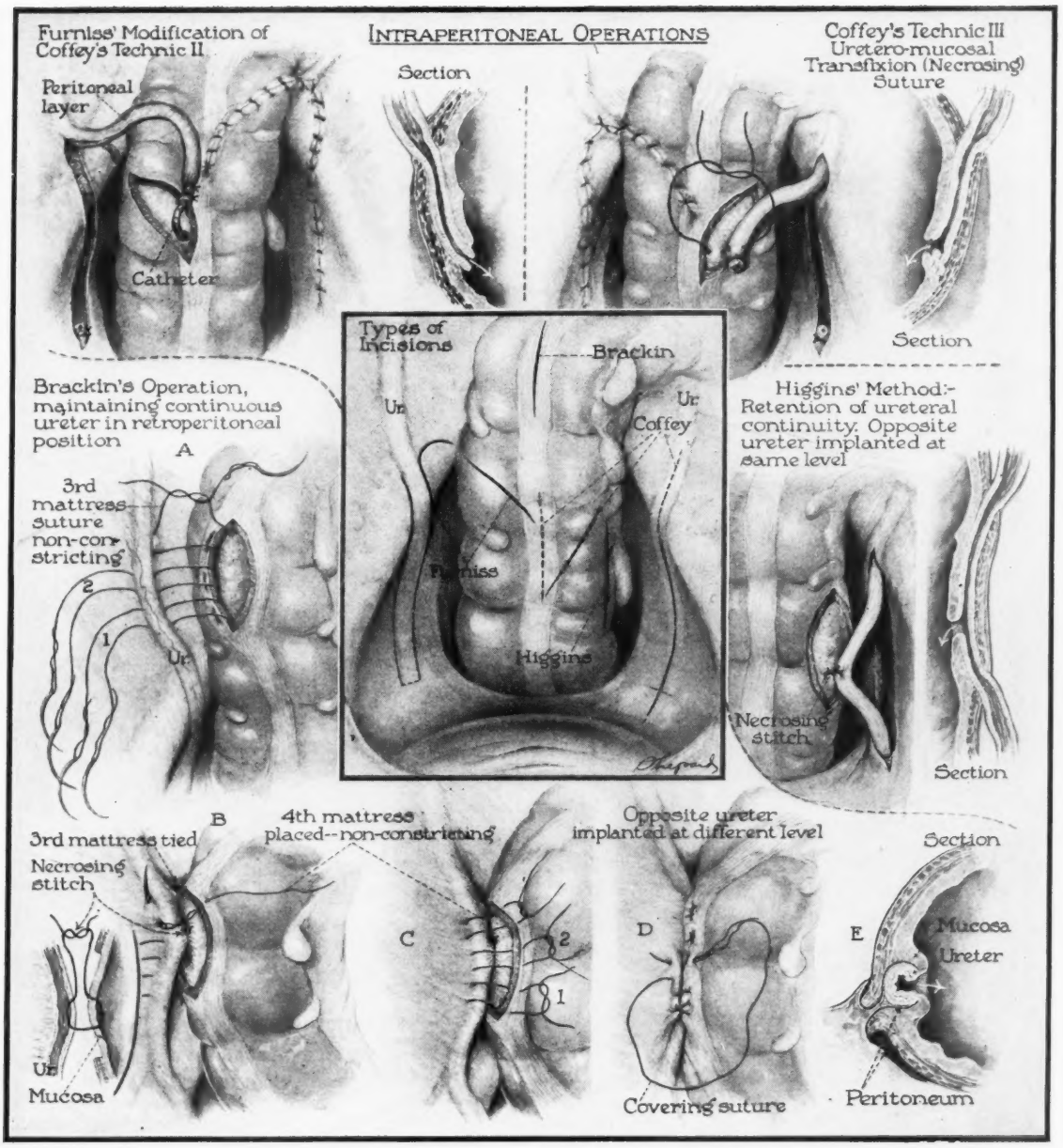

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A PRACTICAL JOURNAL BUILT ON MERIT

NEW SERIES VOL. LII JUNE, 1941 NUMBER THREE

Editorial

YE OLDE EDITORS' BATTLE

SINCE Britain and America have united against der Fuehrer and America has come of age as a world power, it is easy to forget that we were not always so respected. With the hands-across-the-sea sentiment fast developing into a political amalgamation, medical editors of both countries can rejoice that the old feud is dead. American medicine since 1900 has attained world recognition and its puerility is admittedly over.

As Eckman[1] has recently pointed out, before the turn of the century British and American journals often made it a policy to ridicule each other. It was the same narrow self-sufficiency that made George Ticknor's Boston intolerant of budding intellectuality in the rest of America. The battle was joined in 1818 when the *Edinburgh Review* commented thus of a Philadelphia publication: "What does the world yet owe to American physicians or surgeons?" For four years the *Philadelphia Journal of Medicine and Physical Sciences* carried this quotation on its masthead to goad Americans and to keep alive the familial dissension. In his first edition the editor of the Philadelphia Journal complained that: "Ever since the establishment of our Independence it has been the habit of Europe very wantonly to traduce our . . . achievements. Calumnies from this source . . on each repetition (are) marked by fresh acrimony and insolence." Six years later this same Philadelphia editor struck out once more at impertinent and presumptuous English critics and quoted the *London Medical and Physical Journal:* " . . . The editor cannot recollect anything of any consequence that has been done by American physicians and surgeons!"

In 1828, the *Boston Medical and Surgical Journal* joined the conflict and reprimanded the editor of the London *Lancet* for calling prominent practitioners " . . . bats, cocksparrows, ninnyhammers and other (names) scarcely less felicitous . . . " Four months later the Boston editor pounced on a book written by Michael Ward, M.D., of Manchester, England, saying: "The sum total of this work is that burns and scalds may be cured by common wheat flour . . . this much information . . . and no more."

Wakley, editor of the London *Lancet*, proposed in 1830 that poverty-stricken English physicians should be shipped out to America. To this the *Boston Medical and Surgical Journal* howled: " . . . as for gold and silver, one would suppose Wakley believed they grew in our pine trees and paved the streets of our cities . . . " At the time of the founding of the *Maryland Medical Recorder* Wakley dismissed it curtly as "a publication recently started,

and the existence of which will not probably be of very long duration . . . "

In 1835, the *Boston Medical and Surgical Journal* took the opportunity to comment on British medical education by saying: "Dublin University has a board of faculty that are a corporation of perfect spongers . . . , George Allman is a coarse, morose, forbidding medical despot, and England appears to be infested with as many ignorant professional pretenders as any nation on the globe. . . . " Later Dowler, editor of the *New Orleans Medical and Surgical Journal* complained: "Our British brethren are not very indulgent toward us. They blame us because we are deficient in originality and yet when we have the good luck to strike on a vein a little novel, they straightaway claim it for themselves . . . "

Once more in 1870 the controversy was vigorously revived when the *London Medical Times and Gazette* remarked that: " . . . in America . . . the medical newspaper exists only in the most rudimentary form . . . One editor apologized for the nonappearance of his journal one month by publicly announcing that he had had no time to attend to it. On another occasion the same individual accounted for a lot of blunders by the fact that he was off for a holiday when the journal was going through the press. What would our readers say were we to treat them thus?" The editor of the *Nashville Journal of Medicine and Surgery* attempted a rebuttal by means of high-flown classical and allegorical phrases to which the Britisher acidly replied: "We are fain to confess that we do not understand the American language, but are obliged to content ourselves with plain English. . . . "

As the rancor died down in the 1880's, an American editor remarked, " . . . our Texas brethren are to be congratulated that their great state has at last been recognized by the haughty and arrogant Briton, a writer in the British Medical Journal having actually condescended to quote from the Transactions of the Texas State Medical Association."

By 1900, the bitter contention passed away for America had achieved medical greatness and its works were widely acknowledged. Moreover, the appointment of America's Osler to the Regius Professorship of Medicine at Oxford in 1905 stilled the remaining jealousies. Insolence, truculence, bitterness, and bombast very properly disappeared from English and American medical editors and they soon forgot that their forebears had suffered fights of the intensity of a family feud.

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Walter G. Stuck

Original Articles

TIBIAL DEFECTS WITH NONUNION TREATED BY TRANSFERENCE OF THE FIBULA AND TIBIOFIBULAR FUSION

HENRY W. MEYERDING, M.D. AND JAMES H. CHERRY, M.D.
Section on Orthopedic Surgery, The Mayo Clinic Fellow in Orthopedic Surgery, The Mayo Foundation
ROCHESTER, MINNESOTA

PROLONGED disability due to tibial defects with nonunion creates an economic and social problem which brings the patient to the orthopedic surgeon with the hope of avoiding amputation and obtaining a functioning limb. Fortunately, modern reconstructive surgery offers the means whereby the ununited and often infected tibia may be fused with the fibula, thus permitting subsequent usefulness and weight bearing.[1,2] In our experience these patients have usually had repeated surgical procedures and have been disabled for several years. Needless to say, their financial resources have become quite limited. Since the surgeon who is confronted with such problems knows the difficulty in obtaining union in these cases, he is often tempted to resort to amputation as a solution. We desire to report our experience in fifteen cases of nonunion with defect of the tibia treated by means of fibular transference and tibiofibular fusion.

The procedure which insures such a use of the fibula is popularly referred to in this country as the Huntington-Stone operation and is usually carried out in two stages. Huntington, in 1905, reported a case of osteomyelitis of the tibia with great loss of substance in which he had transferred the fibular shaft into the upper and lower tibial fragments with good results. In 1907, Stone carried out a similar procedure on a six year old boy for the same reason and with the same satisfactory result. There were some differences in the technic and the handling of the cases after operation but the surgical principles employed were the same in the two cases. Huntington transferred the osteotomized fibular ends into intramedullary cups prepared in the tibial fragments, whereas Stone cut steps in the fragments of his case and fixed them in an interlocked apposition held tightly by means of the tibial periosteum which he had been careful to preserve for covering. Both authors transferred the lower portion of the fibula at a second-stage operation. Huntington, from the experience gained, pointed out that one should not allow weight bearing between operative stages because such a course would result in disalinement of the ankle mortise with vulgus deformity of the foot, as it did in his case.

Although Huntington and Stone were the first to record in this country cases in which transference of the fibula was carried out for the purpose named, they were by no means the first to conceive such a procedure and to use it. In 1884, E. Hahn reported a case of ununited fracture of the tibia with loss of part of the tibial shaft in which he had transferred a portion of the fibula after osteotomy into the proximal tibial fragment leaving the lower portion of the fibula intact. His result was apparently successful, but he made mention that weight bearing would have perhaps been better if the lower portion of the fibula had also been transferred. Codivilla subsequently perfected the two-stage technic

preceding Huntington and Stone by several years.

One of us (H. W. M.) has been for some time using a devised modification of the Huntington-Stone procedure in certain selected cases. This modification employs the use of the fibula without osteotomy and transference simply by arthrodesis of the upper and lower tibiofibular joints. The advantage over the original technic is threefold: first, the entire blood supply to the shaft of the fibula is left intact; second, the surgical approaches are usually without the field of infection if the latter is present, thus reducing the risk of spreading the infection and allowing operation earlier than if the older technic is used; and third, if the surgeon desires to fuse the tibial fragments with a tibial graft, the modified procedure will afford stabilization and insure greater immobilization without interference in the grafting field. We believe this internal fixation with the fibula is an important factor in obtaining fusion of the tibia. In certain other cases, we have been using a modified combined procedure in which the upper tibiofibular joint is ankylosed and the lower portion of the fibular shaft is osteotomized and transferred in a somewhat similar manner to the second-stage Huntington-Stone operation. These procedures will be outlined in detail later on.

FIG. 1. *a*, Ununited fracture of the right tibia with loss of substance of the shaft before surgical stabilization; *b*, following osteotomy and transference of the fibula at the upper and lower ends.

CLINICAL DATA

In this report we wish to present a total of fifteen cases in which some type of fibular stabilization or transplantation was performed. (Tables I and II.) All had been seen over a period of years from 1914 through 1939 because of nonunion of the shaft of the tibia with moderate to great loss in the diaphysis. In five cases the deformity had resulted from hematogenous osteomyelitis, in nine from fractures and in one from pathologic fracture following osteomyelitis. One or more sequestrectomies had been performed before admission on all of the patients who had had hematogenous osteomyelitis. In one case tibial bone grafting had been attempted with failure. Six of the nine fracture cases had suffered compound wounds at the time of the original injury, three having received shotgun wounds. In two of the nine secondary osteomyelitis had developed following therapeutic measures. Four of the nine fracture cases had been subjected to bone grafting procedures without success; in one case grafting was attempted twice. Altogether six of the nine patients had had open operations of some type in an attempt to obtain union.

Eight of the fifteen patients were male and seven female, the youngest being seven years, the oldest thirty-three years and the average twenty-two years. The average time for the duration of symptoms before being treated here was four years and eight

months, the shortest period being seven months and the longest nineteen years.

The types of procedures employed and the number of cases of each may be outlined as follows: (1) Osteotomy and transference—carried out on eight patients in whom one or both ends of the osteotomized fibula were transferred by implantation or notching into the tibial fragments (on four both the upper and the lower ends were transferred, on three the upper end only, and on one the lower end only); (2) modified (Meyerding) operation—performed on three patients in whom both upper and lower tibiofibular articulations were ankylosed; (3) modified combined (Meyerding) operation—carried out on three patients in whom the upper tibiofibular joint was

TABLE I

CASES OF FIBULAR OSTEOTOMY AND TRANSPLANTATION (HUNTINGTON)

Case	Age, Years; Sex	Occupation	Cause of Deformity	Duration	Region Involved	Type of Procedure Here	Complications	Results and Remarks
1	19 F	Farm girl	Osteomyelitis; sequestrectomy elsewhere	7 years	Right tibia	Upper and lower transplantation	None	Good
2	22 F	Housewife	Fracture; subsequent infection; nonunion	5 years	Left tibia	Upper and lower transplantation	Fell, fractured fibula 2 years later; finally ok.	Good*
3	28 F	Housewife	Shotgun wound; considerable drainage	7 months	Left tibia	Upper transplantation	Recurrent osteomyelitis; amputation after 5 yrs.	Operation good
4	15 F	Student	Shotgun wound; open reduction and bone graft	2 years	Right tibia	Upper transplantation	None	Good*
5	20 M	Barber	Osteomyelitis; sequestrectomy elsewhere	7 years	Left tibia and knee joint	Lower transplantation	Fragments slipped; reoperation	Good
6	9 M	None	Osteomyelitis; 3 sequestrectomies elsewhere	7 months	Right tibia	Upper and lower transplantation	Upper fragments slipped; reoperation	Good†
7	12 F	School child	Osteomyelitis; 3 sequestrectomies elsewhere	3½ years	Left tibia	Sequestrectomy and later bone graft; upper and lower transplantation	Bone graft absorbed, resorted to fibular transplantation	Good
8	33 F	Housewife	Osteomyelitis; later fracture	19 years	Left tibia	Upper transplantation	1. 3 subsequent sequestrectomies; 2. Removal head fibula for peroneal palsy	Good‡

* Pre-existing synosteosis lower tibia and fibula.

† Retardation epiphyseal growth.

‡ Good result with malposition. Pre-existing synosteosis lower tibia and fibula.

ankylosed and the lower end of the fibula transferred to the distal tibial fragment after osteotomy (osteotomy was not necessary in one case because the fibular shaft was already in a suitable position for synosteosis as a result of previous fracture), and (4) fibular graft in the same leg—carried out on one patient in whom a portion of the shaft of the fibula was completely excised from its bed and transplanted as an ordinary autogenous graft. (Figs. 1, 2 and 3.)

TABLE II

CASES IN WHICH MODIFIED PROCEDURES WERE PERFORMED

Case	Age, Years; Sex	Occupation	Cause of Deformity	Duration	Region Involved	Type of Procedure Here	Complications	Results and Remarks
			Tibiofibular fusion					
9	25 M	Truck driver	Compound fracture; previous open reduction	8 mos.	Right tibia	1. Upper and lower fusions; 2. Later reversible tibial graft	None	Good
10	27 M	Physician	Fracture and nonunion; bone graft elsewhere; osteomyelitis	6 yrs.	Right tibia	Upper and lower fusions following 2 sequestrectomies	Temporary peroneal nerve palsy	Good. Some malposition
11	25 M	?	Bilateral tibial fracture with osteomyelitis	9 mos.	Right and left tibia	Upper and lower fusions on right; subsequent sequestrectomies	Chronic drainage	Too early to predict. Still has nonunion
			Combined fusion and osteotomy					
12	23 M	Farmer	Shotgun wound; graft attempted elsewhere	5 yrs.	Right tibia	Upper fusion; lower osteotomy and fusion	Temporary peroneal nerve palsy	Good
13	7 M	None	Osteomyelitis; sequestrectomy and bone graft elsewhere	4 yrs.	Right tibia	Upper fusion; lower osteotomy and fusion	None	Good
14	34 M	Service station	Compound fracture; sequestrectomies elsewhere	19 mos.	Left tibia	Upper and lower fusion	None	Good. Osteotomy not necessary because previous fibular fracture
			Fibular graft same leg					
15	21 F	?	Fracture; open reduction and bone grafts elsewhere	7 yrs.	Left tibia	Excision portion fibula, same leg and grafting	None	Good

The complications arising following the various procedures may be noted in Tables

I, II and III. In three cases, temporary palsy of the peroneal nerve resulted from transplantation or stabilization of the upper portion of the fibula. In two of the cases, the palsy disappeared during conservative treatment, while in the third, excision of the remaining fibular head was necessary before function returned.

Fig. 2. *a*, Ununited fracture of the right tibia with loss of substance of the shaft before surgical stabilization, also fracture of fibula; *b*, following tibiofibular fusion and reversible bone graft with good result.

It is to be noted that in five cases recurrent drainage occurred from pre-existing osteomyelitis. In the case of one woman subsequent amputation was performed elsewhere because of chronic drainage in spite of fibular stabilization which had given a satisfactory weight-bearing limb for about four years. The transferred fibular fragment slipped in two cases following operation and reoperation was done. The final result in each case was good, although in one there was a disturbance in the epiphyseal growth which later gave rise to shortening of the affected limb.

Two years following successful two-stage fibular transplantation, a patient fell and fractured the transferred bone. The fracture united and a useful limb was finally obtained.

The results in all fifteen cases, regardless of the type of procedure used, may be classified as generally good. By good, we mean a limb which could eventually withstand weight bearing without support. Continued use of elevated shoes and braces was necessary in a few cases because of shortening and the desire for added protection. It has already been mentioned that amputation was later done on one patient because of drainage. The lapse of time since operation has been too short in two cases to allow proper evaluation of the results; fusion of the tibia and fibula has been obtained and the indications are that useful limbs will eventually be obtained. In one of these cases, the tibia of the opposite leg suffered a compound fracture which resulted in nonunion despite repeated operation and fibular stabilization is under consideration.

In one case in which arthrodesis of the upper and lower tibiofibular joints was

done, subsequent tibial (reversible) bone grafting was performed and the result has been satisfactory, as shown in Figure 2*a* and *b*.

Fig. 3. *a*, Gunshot wound through tibia with nonunion and loss of substance of the shaft before surgical stabilization; *b*, following arthrodesis of the upper tibiofibular joint and osteotomy with transference of the lower fibular shaft into the tibia.

The results according to types of operative procedures used may be found outlined in Table II.

OUTLINE OF THE MODIFIED OPERATIVE PROCEDURES

Modified (Meyerding) (Tibiofibular Fusion). After the limb has been prepared and the tourniquet applied, an anterolateral incision is made over the head of the fibula extending some 3 inches (8 cm.) over the groove between the tibia and fibula. Special care is taken to avoid traumatizing the peroneal nerve which should lie posterior to the line of incision. The safest measure is to locate this structure and isolate it from the operative field. It is retracted lightly in order to avoid pressure neuritis. The ligaments, cartilage and periosteum are removed from between the two bones with curet and chisel. The underlying bone should be thoroughly

Fig. 4. *a*, Ununited fracture of the right tibia with loss of substance of the shaft before surgical stabilization; *b*, one year following arthrodesis of the upper tibiofibular joint and transference of the lower end of the fibula into the tibia; *c*, same extremity five years after operation; note hypertrophy of fibular shaft.

roughened wherever the surfaces contact. Drilling into the marrow cavity may hasten synosteosis. As a usual thing, internal fixation with foreign materials will not be necessary, but either a vitalium or beef-bone screw may be used if the surgeon desires. The incision is closed layer by layer in the usual manner.

The lower tibiofibular articulation may be ankylosed at the same time or this may be done at a second operation. If it is to be done immediately, the tourniquet should be released temporarily after dressing the wound before one proceeds with the second stage. An anterolateral incision is also made over the external malleolus and the underlying tissues are retracted mesially. The same roughening, drilling and impaction are made as in arthrodesis of the upper articulation. After the incision is tightly closed, a plaster of paris cast is applied

extending from the toes to above the mid-thigh. The knee is held in slight flexion and the foot at a right angle. Canvas straps may be incorporated into the cast to allow elevation of the limb.

Modified-Combined (Meyerding). Since this procedure is more extensive in nature and requires a longer time for execution, it is safest to do it in two different operative stages. The first stage is carried out on the upper tibiofibular articulation in the same manner as in the foregoing procedure.

TABLE III

RESULTS AND COMPLICATIONS COMPARED

Type of Procedure		No. of Cases	Results		Complications	Remarks
			Good	Poor		
1. Osteotomy and transference into prepared bed or notch	Both ends	4	4	0	1 upper fragments slipped, 2nd operation necessary; 1 fractured transferred fibula 2 years later	Union occurred
	Upper only	3*	3	0	1 subsequent amputation for drainage and disability; 1 peroneal palsy requiring excision fibular head	
	Lower only	1	1	0	1 fragments slipped, 2nd operation necessary	
	Total	8	8	0		
2. Modified fusion (upper and lower tibiofibular articulations)		3	1	0	1 temporary peroneal palsy	Too early to estimate results in 2 cases although firm union has occurred at sites of arthrodeses. Good result in case which had reversible tibial graft following fibular operation
3. Modified-combined (fusion upper tibiofibular joint and osteotomy with side to side transference lower fibula)	With osteotomy	2	2	0	1 temporary peroneal palsy	
	Without operative osteotomy†	1	1	0		
	Total	3	3	0		
4. Fibular graft same leg (complete excision of portion of fibula)		1	1	0		
Total.....		15	13‡	0		

* Lower not transferred because bony synosteosis had occurred in three cases between lower fibula and distal tibial fragment due to fracture and infection.

† Osteotomy not necessary in one case because of previous fracture to fibula.

‡ Too early to estimate in two cases.

In the lower end an incision is made along the course of the fibula extending from the ankle joint up about 4 inches (10 cm.). The length of exposure will depend on how high up the shaft the osteotomy of the fibula will be made and this in turn will depend on the length of the lower tibial fragment together with the absence or presence of infection. In carrying the incision down to the bone, care should be taken to avoid the superficial peroneal nerve and the tendons in this region. The anterior peroneal artery may give rise to troublesome bleeding if severed. The interosseous membrane between the tibia and the fibula is cleanly dissected out from the lower articulation to about 2 inches (5 cm.) above the elected site of osteotomy. The ligaments and periosteum are denuded and a bed is prepared on each bone for side-to-side synosteosis. Osteotomy is performed in greenstick fashion or transversely usually about 3 inches (8 cm.) above the ankle and the opposing fragments are impacted together. Multiple drill holes may aid in osteogenesis. Either a screw or a Parham band may be utilized for purposes of stabilization. The wound is closed in the usual manner and a cast is applied.

COMMENT

It is obvious from the results that a fairly substantial limb can be reconstructed by means of fibular transference or tibiofibular fusion. The period of immobilization will depend on the individual case but the usual period between the date of the second-stage operation and the time when weight bearing is allowed will vary on an average of from six months to one year. Weight bearing should be started with some type of support, either a walking cast or a caliper brace. Later a light weight brace extending from the knee down will often suffice. External fixation should be employed until, in the opinion of the surgeon, the roentgenologic and clinical appearance indicate that union is sufficiently strong to stand the stress and strain to which a lower extremity is normally subjected. As can be seen in Figure 4*a*, *b* and *c*, the fibula will become hypertrophied during weight bearing to a degree often approaching the size of the replaced tibia. However, in some patients this hypertrophy is much slower than in others and they will consequently need support for a longer period. As exemplified in one of our cases, the risk of fracture to the fibula is quite possible.

The choice of procedure will depend on the individual case. The merits of the modified operation have already been mentioned. It does not result in providing a direct weight-bearing line such as one can obtain with osteotomy and transplantation, but this disadvantage is by no means a serious one. The modified combined procedure somewhat eliminates this disadvantage and for all practical purposes should serve well. It is to be stated again that if one wishes to stay clear of an infected field or resort to tibial grafting as a third-stage procedure, the simple modified procedure has its technical advantages.

SUMMARY

The use of the fibula for purposes of stabilization in the same leg was found to be indicated in patients with tibial nonunion and associated wide defects and long-standing infections. Two modified operative procedures, employing tibiofibular fusion without osteotomy, were used in six cases. A total of fifteen cases and the results in each are presented in which some type of fibular stabilization was performed with known good results in thirteen cases (86.7 per cent).

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FRACTURES OF THE RIBS

A REVIEW OF 386 CASES

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SHREVEPORT, LOUISIANA

FRACTURES of the ribs constitute one of the commonest lesions in medical literature. In most instances they are regarded as rather benign but, due to their proximity to underlying vital organs and structures, any complication tends necessarily to become a serious one. Consequently, their interest is manifested continuously by the general practitioner, the roentgenologist, the industrial surgeon and the thoracic surgeon. It is the purpose of this article to call attention to some of the past statistics and contribute an additional series of cases which has made up the material for this particular study.

During the past three decades there have been many interesting comprehensive reports relating large series of cases. In 1910, Ziegler analyzed a series of 820 cases of rib fracture showing that the mortality in the series occurred only in the group presenting lung complications.

Ziegler	Total	Recovered	Invalidated	Dead
Fractures without complications	756	753	3	0
Fractures with pleural complications	38	35	3	0
Fractures with lung complications	26	17	2	7

This fact was corroborated by Haubensak in 1923 who reviewed the fractures of the ribs occurring in 1156 Swiss workers. Those with pleural and lung complications represented 13 per cent of the total number of cases. These complications were more specifically designated as pneumonitis in eighteen, subcutaneous emphysema in thirty-one, hemothorax in twenty-four, lung trauma with hemoptysis in twenty-four, pneumothorax in fifteen and tuberculosis in four.

Haubensak	Total	Recovered	Invalidated	Dead
Fractures without complications	990	989	1	0
Fractures with pleural complications	56	56	0	0
Fractures with lung complications	51	30	7	14

Maragliano, in 1913, reviewed 1,528 thoracic injuries with 572 rib fractures in a study of 18,000 war injuries. Of the rib fractures 161 involved only one rib, 294 involved from two to five ribs, and 117 had more than five ribs involved. Only three of these cases had fractures of the costal cartilages. Of his list of complications there was local pleuritis in eight, costophrenic pleuritis in twenty-four hemothorax in six, pneumothorax in three, subcutaneous emphysema in three, traumatic pleuritis in four, traumatic lesions of the lungs in fifteen, traumatic tuberculosis in one and no instance of traumatic pneumonitis.

Bistolfi in 1930 reviewed 200 cases of thoracic injury showing the relation of age to frequency of lung and pleural complications and to displacement of the fragments.

Bistolfi	Per Cent
Those under 40 years without complication or fracture	68
With fracture	32
With complication and fracture	1
Those over 40 years without complication or fracture	45
With fracture	55
With complication and fracture	5

	Cases
Those under 40 years (32 cases) with displacement of fragments	1
Without displacement of fragments	31
Those over 40 years (55 cases) with displacement of fragments	21
Without displacement of fragments	34

More recently, Findlay, in analyzing the injuries admitted at the Beekman Street Hospital through a ten-year period, recovered 551 instances of rib fracture. The mortality of the group was 24.5 per cent, three-fourths of which had other fractures and dislocations.

Fractures of the first rib have received special consideration in the reports of Breslin, Oldfield and Weldon. Collected cases of spontaneous fracture have been reported by Gurlt, Stimson, Richardson and Oechsli. Others have reported rib fracture occurring during parturition and in the insane. Moreover, the literature is abounds with case reports exhibiting such complications as subcutaneous emphysema, mediastinal emphysema, paradoxical respiration, pulmonary abscess, adynamic ileus and hemorrhage from a tear of the subclavian artery. There are likewise many contributions to the therapy of rib fractures with particular reference to the type of strapping, novocain injection and technic of rib resection.

TABLE I
CAUSES OF FRACTURE (ALL FRACTURES)

	No. of Cases		No. of Cases
Fall	108	Muscle pull	5
Auto passenger	96	Cough	57
Struck by auto	57	Pathological	11
Local trauma	37	Unknown	51
Gunshot	3		

This report comprises a study of 386 cases of rib fracture admitted to the University Hospital from July 1, 1934, to January 1, 1940. Of this group 278 were male and 108 female. There was a total of 917 ribs fractured or an average of 2.4 ribs per patient. Table I shows a list of the causes, those associated with fall and auto injuries leading the list. Interestingly enough, three were due to operative trauma in which forceful retraction against the rib in an empyema, thoracoplasty and nephrectomy respectively caused a fracture. Fourteen of the patients who were subjected to a fall were victims of insanity or epilepsy.

TABLE II
SYMPTOMS AND SIGNS (ALL FRACTURES)

	No. of Cases		No. of Cases
Pain	255	Crepitus	13
Tenderness	181	Regional anesthesia	5
Deformity	44	Paradoxical motion	2
Limitation of motion	22	Wheezing	2
Unconsciousness	18	Unknown	59
Dyspnea	17	None	46
Hemoptysis	13		

Those patients having symptoms and signs (Table II) exhibited pain and tenderness predominantly in 255 and 181 instances, respectively. A conspicuous group are eighteen of those showing no symptoms or signs due to unconsciousness, and five with anesthesia due to transverse myelitis. Strikingly enough, there were thirteen patients who had hemoptysis which would infer that the lung had been perforated by the trauma or that bleeding from a chronic lesion had been precipitated. Crepitus was elicited only thirteen times while the signs of inspection, namely, deformity, limitation of motion and dyspnea, were present forty-four, twenty-two, and seventeen times, respectively.

Early cases or acute fractures were considered as those seen before normal rib healing is complete, or four weeks, since many patients were admitted during the latter part of that interval for complications which developed as a result of their fractures. The early fractures totaled 149, but the observer will note that ninety-two were seen during the first seventy-two hours. All of the group of fractures of unknown duration were healed on admission

which excludes them definitely from consideration with the acute category. (Table III.)

TABLE III
TIME SEEN AFTER FRACTURE (ALL FRACTURES)

	No. of Cases		No. of Cases
First 24 hours.....	69	From 1 to 4 months.....	36
Second day.....	13	From 4 to 12 months.....	23
Third day.....	10	Over 1 year.....	129
From 4th to 7th day	16	Unknown.....	58
Second week.....	20		
From 2nd to 4th week.....	21		

TABLE IV
AGE BY DECADES (ALL FRACTURES)

Decade..	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89
Cases....	3	14	36	46	67	96	82	35	7

The ages in the whole series varied from birth to eighty-seven years. (Table IV.) The majority of fractures in both acute and chronic cases were in the fifth and sixth decades, while in the acute group alone, the majority occur in the third, fourth and fifth decades. (Table V.) This latter consideration shows the relation of age in the recent fractures to sex, average number of ribs per patient, number of ribs with multiple fractures, complex position of fragments, rise of the diaphragm and mortality. The mortality takes into account only those patients succumbing due to complications directly related to the rib fracture. The average number of ribs fractured is rather constant for different age groups and is no higher than the gross series. There is a conspicuous tendency for the diaphragm to rise in the fifth and sixth decades, more so than in the other age groups.

The location of the fracture (Table VI) must be considered from several aspects: first, the rib region involved. Here it will be noted that ribs have been grouped conveniently into regions comprising two or three ribs with the exception of the first rib. There is also a designation for the right and left side. Lastly, it is important to ascertain which portion of the rib region is involved, whether it be near the spine or near the costal cartilage. Diagrammatically (Fig. 1), it may be observed that there are certain prominent areas of the thorax which are exposed to trauma. In this series, the posterior and posterolateral portions of the thoracic cage were most frequently involved and the fifth to the tenth ribs were predominant in the other dimension. It is interesting to note that the anterolateral and axillary portions of the first rib are most frequently involved here.

Complications to skin occurred twenty-one times in the acute fractures. These were laceration or penetrating wounds in

TABLE V
ACUTE FRACTURES (BY DECADES)

Age	No.	Male	Female	Aver. No. Ribs	Multip. Ribs	Angulated Overriding Comminuted	Diaphragm Rise Per cent	Mortality Per cent
0–9	1*	1	0	14	0	0	0 (0)	0 (0)
10–19	7	4	3	2.1	0	2	0 (0)	1 (14.5)
20–29	22	14	8	2.9	3	2	3 (13.6)	1 (4.8)
30–39	26	13	13	2.9	2	6	2 (7.7)	2 (7.7)
40–49	30	20	10	2.7	1	7	3 (10.0)	0 (0.0)
50–59	29	23	6	2.1	1	7	6 (20.7)	2 (6.9)
60–69	21	13	8	2.7	0	6	7 (33.3)	2 (9.5)
70–79	11	8	3	2.4	2	3	1 (9.1)	1 (9.1)
80–89	2	1	1	3.5	0	2	0 (0.0)	2 (100)

* Osteogenesis imperfecta—fracture during birth.

four, gross hematoma in five, subcutaneous emphysema in ten, hematoma with deep chest wall abscess in one and hematoma with subcutaneous emphysema in one.

one, empyema in one, gross unilateral effusion in fifteen, bilateral effusion in one, and minimal local or costophrenic pleuritis in six. The fifteen cases of effusion included

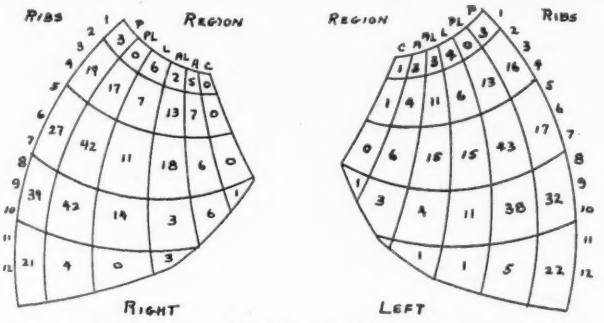

FIG. 1. Regions involved in rib fractures. *C*, cartilage; *A*, anterior; *AL*, anterolateral; *L*, lateral; *PL*, posterolateral; *P*, posterior.

TABLE VI

LOCATION OF FRACTURES (ALL FRACTURES)

Ribs	Right					Left				
	1	2-3-4	5-6-7	8-9-10	11-12	1	2-3-4	5-6-7	8-9-10	11–12
Costal cartilage	0	0	0	1	0	1	1	0	1	0
Anterior	5	7	6	6	0	3	4	6	3	0
Anterolateral	2	13	18	3	3	3	11	15	4	1
Lateral	6	7	11	14	0	4	6	15	11	1
Posterolateral	0	11	42	42	4	0	13	43	38	5
Posterior	3	19	27	39	21	3	16	17	32	22
Multiple	0	3	6	4	0	1	3	2	6	0
Total	16	60	110	109	28	15	54	98	95	20

TABLE VII

COMPLICATIONS (RELATION TO AGE AND SEX)

Sex and Decade	Male	Female	0	1	2	3	4	5	6	7	8	Total
Skin complications	16	5	0	3	5	1	3	3	4	1	1	21
Pleural complications	31	8	0	4	7	7	6	6	7	1	1	39
Lung complications	25	9	0	3	9	4	7	4	4	3	2	34
Rise of diaphragm	22	7	0	1	7	4	6	4	4	2	1	29
Bone complications	4	7	0	0	2	2	1	1	4	1	0	11
Severe traumatic shock	6	1	0	0	1	2	0	0	2	0	0	7
No complications	44	35	1	3	10	15	18	19	8	5	0	79

Complications to pleura were present in 39 of the acute cases. There was simple unilateral pneumothorax in five, tension pneumothorax in three, hemopneumothorax in four, tension hemopneumothorax in three patients with hemothorax proved by aspiration.

There were thirty-four cases presenting lung complications following recent fractures. These were representative of atelec-

tasis in two, pneumonia or pneumonitis in twenty-four, laceration of the lung in six and pleuropulmonary fistula in one.

There were no mediastinal complications in this series, nor were there any concomitant injuries to heart, pericardium or esophagus. However, seven of the acute cases presented severe traumatic shock on admission which minimized the importance of their rib fractures in regard to therapy. In the group of old fractures were two patients with diaphragmatic herniae precipitated by the cause of the fracture.

seventh and eighth decades develop complications than those who escape.

A consideration of the region involved to the complication (Table VIII) reveals some interesting facts. Skin and pleural complications occurred predominantly at a higher rib level than the general location of fractures. Moreover, pleural complications occurred twice as frequently on the right side as the left. Skin and pleural complications occur about three to four times as frequently in the anterior, anterolateral and lateral portions of the thorax than the

TABLE VIII

COMPLICATIONS AND OTHER BONES (RELATION TO RIB AND REGION)

Ribs and Region	Aver. No. Ribs	Right					Left					C	An	Al	L	Pl	P
		1	2-3-4	5-6-7	8-9-10	11-12	1	2-3-4	5-6-7	8-9-10	11-12						
(a)																	
Skin complications	3.6	2	6	1	3	1	1	4	3	0	0	0	4	1	6	4	6
Pleural complications	4.0	3	11	5	6	1	2	6	4	1	0	1	3	6	4	15	9
Lung complications	4.0	3	6	4	3	0	2	5	6	5	0	1	1	5	6	9	11
Rise of diaphragm*	4.0	3	11	5	5	1	4	8	6	3	0	0	5	7	8	12	12
Bone complications	4.0	0	6	2	2	1	1	2	5	3	0	1	0	5	4	9	3
(b)																	
Sternum	1.8	2	1	1	3	2	2	1	1	1	0	3	2	5	2	0	4
Right clavicle	4.2	2	6	7	2	1	1	3	0	1	0	0	1	2	1	2	17
Left clavicle	4.4	0	1	1	3	3	2	9	6	5	2	1	1	2	2	7	19
Dorsal vertebrae	3.4	3	6	9	7	5	2	4	2	5	4	0	1	2	2	10	31
Right scapula	3.2	0	3	1	1	0	1	1	2	1	0	0	1	4	0	4	1
Left scapula	4.2	0	1	1	1	0	1	4	2	0	0	0	0	1	2	2	5
Cervical trans. processes	1.0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Dorsal trans. processes	6.0	1	2	2	1	0	0	1	0	0	0	0	0	0	0	1	6

C—costal cartilage. An—anterior. Al—anterolateral. L—lateral. Pl—posterolateral. P—posterior.
* Complicated cases only.

Bone complications occurred only eleven times as a four-week period is a fairly limited span for such complications to occur. These were delayed union in one, nonunion in four, osteomalacia in one, osteomyelitis in two, excessive callus in two and bridging of the ribs in one.

In Table VII these acute complications are studied with relation to age and region of the thorax involved. Generally, it can be seen that as the age advances, there is more likelihood of serious complication. This feature progresses with a gradual reversal of the ratio, in that more patients in the

corresponding general series of fractures. However, the number of skin and pleural complications is about equally distributed from the anterior to the posterior aspect of the rib. Lung complications are likewise more predominant in rib fractures of a higher lever than average, but conform to the general series of fractures in that they predominate in the posterolateral and posterior segments. It is natural to expect relatively few lung complications to occur in fractures of the eleventh and twelfth ribs, most of the latter bones being situated below the level of pulmonary parenchyma.

Bone complications also show a definite tendency to occur more frequently at a higher rib level than the control series, and to follow more anterolateral and axillary fractures than the general distribution of fractures would indicate.

mortality in the complicated series was as follows: skin complications, 23.8 per cent; lung complications, 23.5 per cent; pleural complications, 18.0 per cent; and diaphragm rise in 13.8 per cent.

In regard to the amount of diaphragm rise, Table x indicates the extent of this complication. For basis of control figures, the rise of the diaphragm in all fractures, including healed cases is included. Peculiarly enough, the diaphragm on the side opposite the rib fracture was elevated in five cases. This, one may assume to be the result of a contre-coup type of injury. There were twenty-nine cases of acute diaphragmatic elevation exhibiting other complications, viz., to skin, pleura, lung and cardiovascular system. Consequently, two-fifths of the cases in which diaphragmatic rise occurred were indices of other series complications. (Tables vii and viii.)

An analysis of other bones fractured with rib fractures brings many interesting points to mind. (Table viiib and xii.) The sternum was fractured four times, the right clavicle twelve times, left clavicle sixteen times, dorsal vertebrae twenty-two times, right scapula four times, left scapula five times, cervical transverse processes once and dorsal transverse processes twice. The average number of ribs fractured in cases exhibiting other fractures was well above

TABLE IX

FRACTURE COMPLICATIONS (RELATION TO POSITION OF FRACTURE, OTHER FRACTURES, AVERAGE NUMBER RIBS, MORTALITY)

	Aver. No. Ribs	Other Frac.		Overriding		Comminuted	Angulated	Other Pos.	Mortality	
		No.	Per Cent	No.	Per Cent				No.	Per Cent
Skin complications	3.6	10	47	7	32.8	2	1	11	5	23.8
Pleural complications	4.0	14	36	13	30	2	1	23	7	18
Lung complications	4.0	11	32	9	26.5	2	3	20	8	23.5
Severe traumatic shock	3.6	3	43	2	29	0	0	5	5	71
Rise of diaphram*	4.0	10	29	9	31	1	2	17	4	13.8
Bone complications	4.0	2	18	3	27.3	1	0	7	0	0
No complications	2.1	11	14	6	7.6	4	1	66	0	0

* Complicated cases only.

In comparing fracture complications with uncomplicated fractures (Table ix), it is apparent that the average number of ribs per patient is approximately twice that of the latter group. Again, it can be seen that overriding of fragments produces complications almost four times as often as none. When other bones are fractured, complications of the skin, lung, pleura and diaphragm rise occur from two to four times as frequently as in uncomplicated cases. The

TABLE X

EXTENT OF DIAPHRAGM RISE

	Acute Fractures	All Fractures
Unknown	7	21
None	96	306
Right—1 interspace or less	16	23
1 to 2 interspaces	13	13
2 to 3 interspaces	2	3
Left—1 interspace or less	12	16
1 to 2 interspaces	1	1
2 to 3 interspaces	0	1
Both diaphrams—1 interspace	2	2

the control series as will be noted. From the tables, the left clavicle is more prone to complication than the right. Moreover, fractures of the vertebrae carried complications in over half the cases in which they occurred. It is apparent that fractures of the first rib are frequent with fractures of the clavicles, scapulae and dorsal spine, more so than when none of these bones is fractured. The distribution of ribs fractured on the other hand is not unusual except that there is a tendency for a higher level of fracture corresponding to the side on which the accessory bone was fractured. This can be due to the nature of the injury and direction of the force.

An interesting group are the double fractures of ribs. These occurred in seventeen patients (Table XI) as double breaks in fifteen and as triple fractures in two. The majority of double fractures occurred in the fifth to tenth ribs as in single fractures. The types of fracture were predominantly (1) posterior and anterolateral (sixteen times) and (2) axillary and anterolateral (ten times). Multiple fractures of the rib did not produce any skin complications but produced pleural complications in four cases, lung complications in five, bone complications in one and elevation of the diaphragm in five, while only two patients exhibited no complications. Other bones

TABLE XI

MULTIPLE FRACTURES (17 PATIENTS)

Rib	Type I	Type II	Type III	Type IV	Type V	Type VI	Total
	Posterior-posterior	Posterior-axillary	Posterior-anterior	Postero-lateral-anterior	Axillary-anterior	Posterior-axillary-anterior	
Right 1	0	0	0	0	0	0	0
2-3-4	0	0	2	1	3	0	6
5-6-7	0	0	6	0	3	1	10
8-9-10	1	0	6	0	0	1	8
Left 1	0	1	0	0	0	0	1
2-3-4	0	2	1	0	3	0	6
5-6-7	3	0	0	0	0	0	3
8-9-10	1	0	1	0	1	0	3
Total	5	3	16	1	10	2	37

TABLE XII

OTHER FRACTURES (RELATION TO COMPLICATIONS AND MORTALITY)

	No.	Complications						Comminution Overriding Angulation
		Mortality	Skin	Pleura	Lung	Shock	Bone	
Sternum	4	0	2	1	1	0	2	3
Right clavicle	12	0	1	1	2	1	0	2
Left clavicle	16	0	3	6	3	0	4	7
Dorsal vertebra	22	0	11	6	8	1	0	7
Right scapula	4	1	1	3	1	1	0	0
Left scapula	5	0	0	1	0	0	1	4
Cerv. trans. pro	1	0	0	0	0	0	0	0
Dors. trans. pro	2	0	0	0	1	0	0	0

were fractured in four cases in this group. The mortality for all multiple fractures was 5.9 per cent.

TABLE XIII
FRACTURES OF THE FIRST AND TWELFTH RIBS

Causes	1st rib	12th rib
Fall	5	4
Muscle pull	2	2
Auto passenger	13	3
Cough	3	0
Pathological	1	0
Unknown	2	3
Right side	12	6
Left side	10	5
Bilateral	4	1
Alone (no other ribs)	6	8

The first rib was involved twenty-six times in this series. The fracture occurred on the right in twelve, left in ten and bilateral in four. Moreover, this rib was fractured alone on six occasions. Table XIII shows the various causes of first rib fractures. One rib was fractured in two areas.

The twelfth rib was fractured less frequently. There was a total of twelve such fractures, six on the right, five on the left and one bilateral. The twelfth rib was unaccompanied by any other fracture in eight cases. (Table XIII.) One case had a fracture of the first and twelfth ribs along with other fractures, and one tuberculous patient had a bilateral eleventh rib fracture with no other bones involved.

Another interesting group in this series are those due to cough, sneeze or other involuntary effort. (Table XIV.) There were fifty-six such spontaneous fractures and interestingly enough, twenty-four had no symptoms and forty went untreated. Nine were due to tuberculosis, twenty-two to asthma, two to postoperative voluntary cough, five to intrathoracic tumors producing cough, four to pneumonia, six to cardiac cough and four to chronic nontuberculous pulmonary infections, mainly bronchiectasis. Eighteen of them were seen from the onset and are tabulated as early cases. The average number of ribs fractured per patient was not much over one, but the region involved is characteristic. It will be noted that the anterior, anterolateral and lateral portions are more prone to fracture here, particularly the ribs of the midthorax (5 to 8). Both sides were involved almost equally, the right thirty-six and the left thirty-two.

There were twelve pathological fractures in this series of cases. These were represented as follows: Multiple myeloma in one, bronchogenic carcinoma in one, metastatic hypernephroma in two, metastatic carcinoma of the breast in three, metastatic carcinoma of the parotid in one, neurofibromatosis in one, myelogenous leukemia

TABLE XIV
FRACTURES DUE TO COUGH (RELATION TO RIB REGION)

	No. Early	No. Late	Aver. Rib No.	Right: 1	Right: 2 3 4	Right: 5 6 7	Right: 8 9 10	Right: 11 12	Left: 1	Left: 2 3 4	Left: 5 6 7	Left: 8 9 10	Left: 11 12	Region: Cc	Region: Ant	Region: Anl	Region: Lat	Region: Pol	Region: Pos
Tuberculosis	2	7	1.8	0	0	3	2	0	0	1	3	2	1	0	0	2	0	5	5
Bronchial asthma	5	17	1.6	0	0	7	10	1	0	0	5	4	0	0	2	2	2	16	6
Voluntary postoperative cough	2	0	1.0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Intrathoracic tumor	3	6	1.3	0	1	1	0	0	0	0	4	5	0	0	0	5	1	4	1
Pneumonia	3	1	1.0	0	1	0	2	0	0	1	0	0	0	0	0	0	0	2	2
Cardiac cough	1	5	1.0	0	0	2	1	0	0	1	2	0	0	0	0	2	1	2	1
Bronchiectasis, etc	2	2	1.8	2	0	1	0	0	1	0	1	1	0	0	0	0	4	0	2

in one, osteogenesis imperfecta in one and squamous cell carcinoma of the chest wall in one. There was no special predilection for rib region or portion of a rib involved in any of these. The case of osteogenesis imperfecta was recognized at birth when fourteen ribs were fractured and no complication ensued.

Table xv
PATHOLOGICAL FRACTURES

Multiple myeloma	1
Bronchogenic carcinoma	1
Hypernephroma	2
Metastatic carcinoma of breast	3
Of parotid	1
Neurofibromatosis	1
Myelogenous leukemia	1
Osteogenesis imperfecta	1
Squamous cell carcinoma of chest wall	1
Total	12

One is always interested in the positive diagnoses for rib fracture. In this series, fracture was suspected in 163 patients. Other bones were suspected to be fractured and found to be rib fractures in eight. Other diseases were suspected where rib fracture was present eighty-five times, and 130 cases were discovered by routine films.

The therapy administered in all fractures was as follows: unknown in forty-one, none in ninety-one, expectant in 132, strapping of the chest in 108, deep irradiation for pathological fracture in three, and intratracheal suction in four. Three of those subjected to the last named form of therapy had pneumonitis and all survived. The fourth had audible intrabronchial mucus which was regarded as a serious forerunner of pneumonia if not relieved. This mode of therapy has been regarded, therefore, as an effective prophylaxis when bronchial secretions are not effectively raised. Four patients had late excision of the fracture site and intercostal neurectomy for painful rib, and three others had other types of surgery, including biopsy. Nerve injection with novocaine or alcohol was not practiced in this group of cases.

The results of all fractures may be listed as follows: unknown, one; dead from rib fracture, eleven; dead from other causes, fifteen; living and asymptomatic, 326; living with painful rib, sixteen; living, but too soon to evaluate, six; living, but ribs involved with other disease at the time of discharge from the hospital, eight; and living with marked deformity, three.

SUMMARY

A series of 386 rib fractures have been presented which comprise those cases admitted to the University Hospital over a five and one-half-year period. These were studied as to cause, symptoms and signs, and location of fractures. When complication accompanied the fracture the mortality varied from 23 per cent to 71 per cent, while the patients in the uncomplicated group all survived. These complications have been studied in relation to location of fracture, other bones fractured and the average number of ribs involved. There are some interesting groups of cases considered, namely, the spontaneous fractures of ribs, double fractures of ribs and the pathological fractures. A few other large series of case reports of other observers are included in the article for comparison of results.

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A CRITICAL APPRAISAL OF THE LEG LENGTHENING OPERATION

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THE problem of unequal leg length is one that is frequently presented to the orthopedic surgeon. There are four methods in use to overcome the difficulties attendant on the condition:

1. The *first* and simplest is some form of apparatus for elevating the foot of the short leg.

2. *Second*, shortening the well leg by a removal of a portion of bone.

3. *Third*, stopping the growth of the longer leg by destruction of one or more of the epiphyseal lines.

4. *Fourth*, lengthening of the bones of the affected leg.

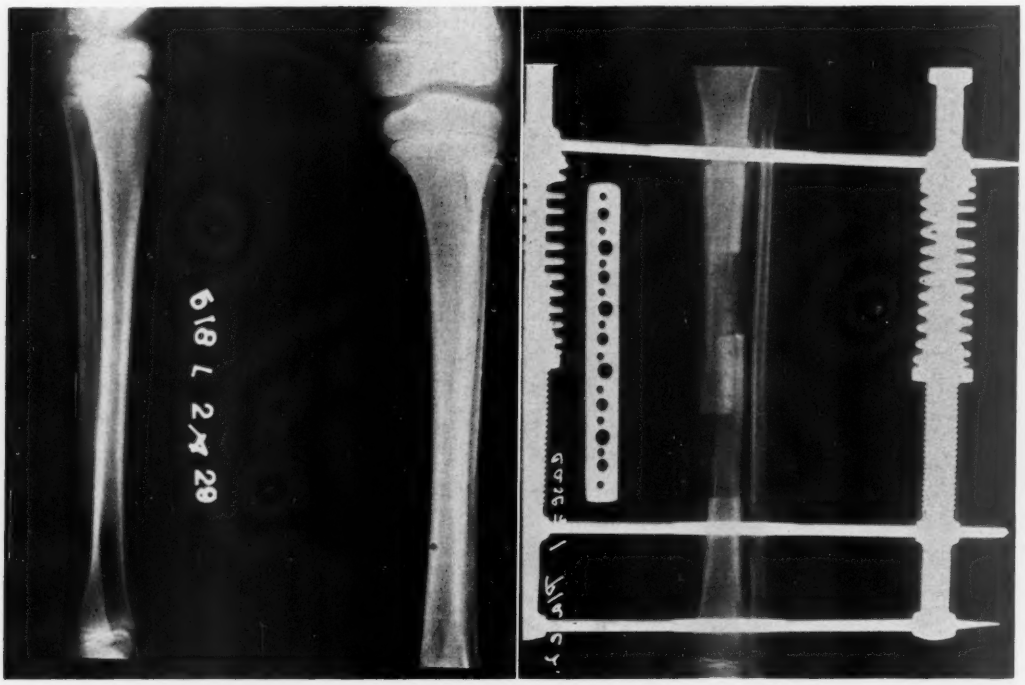
The first is undoubtedly the least risky yet it is significant that the three surgical methods have been developed in an effort to overcome certain objections to this one. These three surgical approaches to the problem have all been done in enough cases that they may be considered to have been proved entirely feasible.

Our own choice of the lengthening operation was based on the very simple consideration that since all of the surgical methods were open to obvious possibilities of disaster in any individual case, we preferred to work with the leg which was already impaired. In other words we did not want to take the chance of having two bad legs instead of one. Since Abbott published his paper on bone lengthening in 1924 rather numerous cases have been reported by Finkelstein, Carrell, Compere and others.

Most of the papers on the subject have dealt with operative technique to a greater degree than with the end results of the operation. We have felt for some time that a study of the end results of the operation would be timely, and with that in mind we have made an effort to get in touch with our longest standing cases during the past year or two. As this study progressed we found ourselves wondering whether the value to the patient of the results obtained was commensurate with the undoubted difficulty of the operation to both the surgeon and the patient. This led to an attempt to balance one against the other in an appraisal of results as we see them. To state the proposition more baldly, we have attempted to make this paper a scientific study rather than a sales talk for the operation. We may point out that the results we are interested in are not so much the lengthening of the leg as the effect on the gait of the lengthening obtained. We have found definitely that lengthening a short leg does not always improve the gait, and if the gait is not improved the result cannot be counted as good no matter how successful the lengthening may have been. Function must be regarded as the essence of the matter.

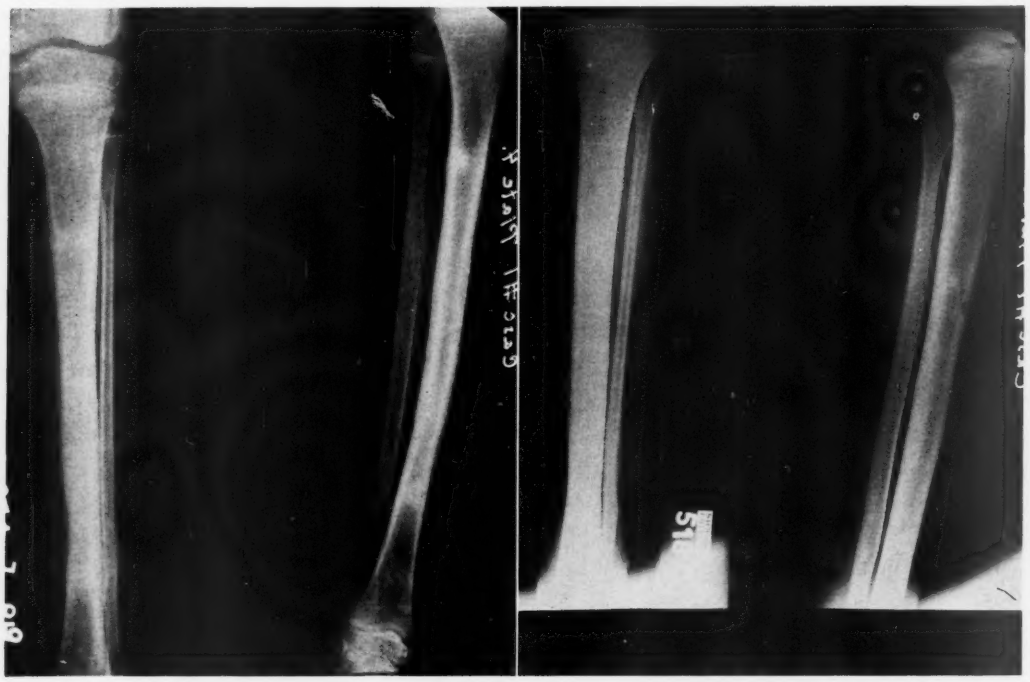
The definition of end results needs a little further qualification, in regard to the age of the patient. Most of the bone lengthenings have been done in children. Complete end results in these cases are not to be judged until the child has gone through the period of rapid growth that takes place at adolescence. Some surprises (not to say shocks) may result. In studying our results we have been especially interested in those cases which have passed through this period of rapid growth.

Bone lengthenings have been done in fifty-two cases: nine of the femur; two of the radius; and forty-one of the lower leg. Those of the lower leg are the only ones considered here since the femur offers some-



A B

Fig. 1. A, Case 1. Preoperative tibial length ten and one-half inches. B, two months postoperatively. Apparatus in position, lengthening obtained and callus forming; some absorption and irritation around upper pin.



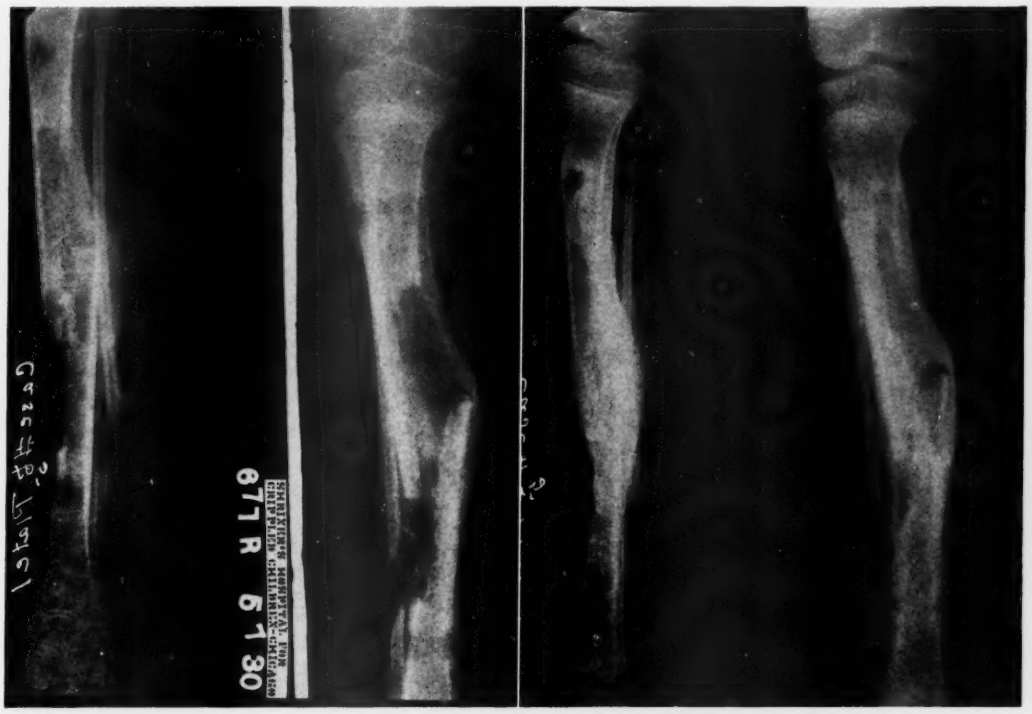
C D

Fig. 1. C. April 20, 1930, one year and two months postoperatively. Medullary canal and cortex well differentiated; pin holes closed. D, May 27, 1938, nine years and three months postoperatively. Tibia appears practically normal; tibial length now seventeen inches.

what different problems and the two of the radius were special cases.

In the forty-one cases the cause of shortening was poliomyelitis in thirty-seven. In two other cases the shortening was confined to the tibia and was the result of epiphyseal injury from over-enthusiastic manipulation of club feet. Two cases were congenital shortenings—one with an absence of the fibula and the other a congenital hemiatrophy. The first operation was done in 1929. We have chosen for special study nineteen cases in which operation was done long enough ago for the patient to have passed through the rapid growth of adolescence. We feel they can be fairly considered as end results. This includes all the cases from 1929 to 1934, except for one which was not checked for a five year result. The oldest patient is now 24 years of age and his leg lengthening was done ten years ago. All of this group were poliomyelitis cases.

In this group the lengthening obtained was from 1½ to 2⅞ inches, with five over 2 inches and five under. These measurements were made on the *x*-rays taken from time to time to check the progress and precautions were taken against distortion by the divergence of the rays. This accounts for the recording of the figures in eighths of an inch. The group was all checked for five years and some for longer on the following points: first, maintenance of length; second, development of deformities in the leg following the operation; third, changes in muscle power following the operation; fourth, the gait, that is, the function of the leg.



A B

Fig. 2. A, Case v. May 7, 1930, three months postoperatively. Bone infected, but callus forming; fragments displaced; sequestrum forming at upper end of lower fragment. B, July 16, 1930, six and one-half months postoperatively. Bone firmly united in poor position; sequestrum fully formed.

Maintenance of Length. Of the nineteen patients only one has failed to maintain the leg equality even after a growth of several inches in height. In this case one leg was lengthened 2 inches at the age of 12 years. The length was maintained for over a year but in the three following years the patient grew rapidly and the operated leg fell behind 1½ inches. On the other hand in another patient operated on five years ago

the equality was maintained for over a year and then the leg operated on began to forge ahead so that it is now 1½ inches longer

Fig. 2c. June 19, 1931, sixteen and one-half months postoperatively. Sequestrum removed; solid union; medullary canal forming; bone straightening by use; lengthening retained in spite of infection.

than the other. Furthermore the variation is all in the length of the lower leg. In two other cases the operated leg has outgrown its fellow 1 inch, making three cases in which this has happened to a definite extent. The maintenance of length has been quite uniform and a fairly high proportion of the cases (three in nineteen) have shown more rapid growth than the normal leg. This maintenance of the length is somewhat surprising in view of the fact that there does not seem to be anything in the operation itself which would change the underlying conditions which caused the shortening—or more accurately—the de-delayed growth of the affected leg. The factors which cause the delayed growth of the bone are not definitely known.

In our experience shortening in poliomyelitis cases is associated only with severe paralysis. The paralysis may be sharply localized, for instance to the leg below the knee, but it will be of high degree to cause shortening and it must involve a large part of the musculature. I have never seen it, for instance, where only the anterior tibial muscle was affected. These common observations have led to the assumption that delayed growth was due to the lack of circulation associated with the severe muscle paralysis. Some have considered it due to circulatory changes from direct affection of the sympathetic system by the poliomyelitis virus. It may be due to other neurotrophic disturbances, though I believe the physiologists frown on the belief of direct trophic nerves. It may be due to the lack of some normal stimulation to bone growth from the action of muscles attached to the bone. It is difficult to conceive how the lengthening operation could change any of these factors enough to cause the bone to resume growth at a rate equal to its normal fellow. Probably the growth impulse is something considerably more complex than any of the factors we have mentioned.

The three cases in which the lengthened bone outgrew the other leg (and the same thing is happening in other patients not yet old enough to be counted as end results) offer another problem. It is easy to assume that there has been a stimulation to the epiphyseal lines which caused increased growth, but it is difficult to explain its mechanism and why it should continue so long. Furthermore experimental animal work attempting to obtain increased growth through epiphyseal stimulation has not been brilliantly successful. Wu and Wiltner report some experimental work on animals in which they obtained increased growth in long bones by stripping the periosteum, but the increased growth was small and occurred only in a short time after operation. They did not reach any conclusion as to the mechanism by which the lengthening was obtained. The periosteal stripping is done in the bone lengthening operation but the growth apparently

continues for several years. Compere and Adams observed that overgrowth sometimes followed removal of a graft from the growth took place long after healing was complete and the bone had become quite normal so far as the *x*-ray appearance was

A B

Fig. 3. A, Case IX. Preoperative condition. B, January 7, 1931, three and one-half months postoperatively. Good callus; beginning differentiation of medullary canal.

tibia of a well leg. Their conclusions were that "(1) Minimal trauma to the shaft or the metaphysis of a long bone with or without interruption of the medullary blood supply does not produce any definite increase in rate or extent of longitudinal bone growth. (2) Gross trauma involving a considerable portion of the shaft of a long bone and necessitating repair over a long period of time does produce epiphyseal stimulation and longitudinal overgrowth. (3) The increased rate of growth continues only during the period of healing. (4) This growth stimulation appears to be secondary to the hyperemia and increased vascularity of the bone and soft parts following the trauma and during the process of healing." A leg lengthening operation can be justly classed as gross trauma, thus fitting into Compere's second conclusion. However, the third conclusion does not fit so well. In the three cases mentioned the increase in concerned and presumably when the circulation was also back to normal. As a matter of fact the mere maintenance of length seems to me to imply a relative overgrowth, inasmuch as the leg had previously dropped behind the normal leg. To be able to control and apply such a stimulus by less drastic means than a leg lengthening operation would be to the advantage of both the patient and the surgeon. At any rate it is an interesting question in the physiology of the bone growth, and we are still following it up. Whatever the difficulty in explaining it, the fact remains that the lengthening obtained has been quite uniformly retained past the adolescent stage of rapid growth. Along with the maintenance of growth there has been, of course, an improvement in posture from the leveling of the pelvis. Also the associated compensatory scoliosis was relieved. So far as the equalization of leg length and its maintenance is concerned

we feel reasonably assured. Some interesting research problems are also opened up for investigation.

Fig. 3c. May 14, 1931, six and one-half months postoperatively. Medullary canal and cortex well differentiated; unusually rapid restoration.

The second point on which these nineteen cases were specifically checked was development of deformities in the leg following lengthening. In this connection we are not considering the deformities that may arise from displacement of the fragments during the lengthening process but rather slowly developing deformities resulting apparently from internal changes in the bones due to the altered mechanics of the lengthened bone. The slight displacement that may occur during the lengthening process disappears, so that usually at the end of a year or at most two, the bone is quite normal in roentgenographic appearance. However, there is a distinct tendency to develop two deformities, a valgus foot and a tibial twist associated with a knock-knee deformity.

In the nineteen cases we are considering, sixteen were badly paralyzed in the affected leg and had already a mild degree of knock-knee deformity. This deformity increased markedly in eight of the cases and as the weight bearing shifted more to the inner side of the foot, the latter was forced into a valgus position. These patients all had weak hip abductors. Both of these effects we have ascribed to the fact that after leg lengthening a new technique of walking had to be developed. In a sense the leg had been artificialized and the easiest way to use it was to evert the foot and roll the knee in. Wolf's law did the rest. These eight patients also lost a considerable part of the motion of the ankle joint—one of them lost ankle motion completely and it was perhaps this which led to the development of the peculiar gait mentioned, though we believe that the fact that the hip abductors were weak had much to do with it. As we see it, a leg lengthening adds to the strain on the hip abductor group and the resulting gait is an effort to relieve the strain on this group. It is an exaggeration of the gait often developed by patients with weak hip abductors, the result of an effort to move the leg inward under the center of gravity, rather than swaying the body over the leg. In this group of slowly developing deformities we must include one unusual result. One girl of 14 whose leg had been lengthened 2 inches developed a slowly increasing limp after leaving the hospital and walking for several months. It was found that the head of the femur had dislocated completely from the acetabulum which was shallow and poorly formed. Whether the acetabulum had changed its contour following the leg lengthening we do not know, but it was noted previously that the hip was somewhat unstable and the hip abductor group weak. A Schanz osteotomy restored some of the hip stability but, of course, left the leg shorter than the other.

The third point considered in the study is *changes in muscle power following the leg lengthening.* Most of these patients were badly paralyzed and we did not expect that there would be any increase in muscle power as the result of the operation. In that we were not disappointed. But in one case in this series with a fairly good quadriceps

there was a loss of power so that the quadriceps is now graded as poor. Whether this loss is actual or relative on account of the changes in leverage from the increased length of the tibia is not quite clear. Lengthening in this case amounted to approximately one-seventh the length of the tibia or an increase of 14 per cent in the long arm of the lever with a corresponding increase in load. It is quite possible that the quadriceps did not have the reserve power to take care of this extra load. We have had the same thing happen in another patient not yet old enough to be included in this series of end results.

The fourth point of study is the effect of leg lengthening on the gait. We have already mentioned that leg lengthening does not always make the patient walk better—a conclusion which seems perfectly logical and apparent now but which needed some experience, observation and reflection. In checking the gait of the group we have classified the end results as (1) walking better, (2) no better and (3) worse. Six were classed as better, nine as no better and four as worse. These results are nothing to cause overweening pride and we believe they were largely due to failure to recognize the fact that there were two elements in the limp present before operation—the element of muscle weakness and the element of shortening. Perhaps it would be more accurate to say we did not properly evaluate the relative weights of the two elements. To illustrate this point the number of operations each year is of interest. In 1929 there were three; 1930 ten; 1931 none; 1932 one; 1933 two; 1934 four. The thirteen done in 1929 to 1930 accounted for nine of the thirteen results classified as no better or worse. By that time we were beginning to learn by observation to distinguish between a favorable and an unfavorable case and to select our cases more carefully. It was noted that the cases not improved in gait were those with weak quadriceps and hip muscles, particularly the so-called hip abductors which do not abduct the hip at all in walking, but do fix the pelvis. It is this group of pelvis fixators which have accounted for most of our failures. With a lengthened leg more strain is thrown on this group than with a short leg and the limp due to them correspondingly increases. Cases in which the major element of the limp is from weakness of the hip abductors, or as we prefer to call them, the pelvis fixators, will not be benefited by lengthening the leg. Cases in which the main element of the limp is due to the mechanical disadvantages of a short leg will be much improved. Paralysis of the quadriceps does not seem to be quite so vital an element affecting the gait after a leg lengthening except for the possibility we have already mentioned that its relative power may be changed by the lengthening of the leg. Of course quadriceps weakness and hip abductor weakness are usually associated, but in these cases the quadriceps does not seem to be the vital factor in the resulting limp. One patient in whom the quadriceps was strong while the gluteus medius was weak is walking better though it was with some misgivings that the operation was done.

In order to make a fair appraisal of the value of leg lengthening it seems necessary to consider briefly some of the difficulties of the operation itself. In this we include observations made on all forty-one of the cases, not confining ourselves to the twenty considered as end results.

The difficulties we feared before we began the operation were infection, failure of union, displacement of the bone and displacement of the foot. As to infection we had three, one of the bone and two skin-stitch abscesses. While this is a much higher percentage than we have had in other operations, we do not believe it is quite fair to blame it entirely on the operation. The one severe infection was apparently due to outside circumstances and operating on that particular day was an error in judgment. Nonunion has not occurred as yet. This we are more inclined to attribute to luck than to any special precautions. Incidentally we do not use a

motor saw, but split the bone with a thin blade osteotome, but whether this has anything to do with it is doubtful.

Displacement of the fragments has not been troublesome, though it has occurred to a moderate extent in a few cases. We have noted that in practically every case there is a slight displacement as the longitudinal cut of the bone is completed. The bone springs slightly from its former shape. This is apparently due to the fact that the tibia has a definite grain, as a piece of wood might. This grain is somewhat spiral and seems to be associated with some internal strain of the bone, which causes the springing action noted. Displacement of the foot has been much more troublesome. In two cases it was marked and necessitated secondary operations. It occurs to a lesser degree in practically all cases. The amount and direction of the displacement is determined by the balance of the power in the muscles. We now make it a rule to leave any foot stabilization operation that may be needed until after the lengthening has been obtained. The stabilization procedure can then be modified to meet the individual deformity.

In connection with the foot and ankle we have encountered another unanticipated difficulty. Most of the patients experience some loss of ankle motion. In a number there has been almost complete loss of motion but no ankylosis as shown by *x*-ray. Since most of the patients operated on have had almost flail ankles, a certain amount of blocking of ankle motion does no harm, but complete loss is likely to lead to marked eversion of the foot with an awkward gait. This loss of ankle motion we account for as follows: In our cases we have noted a rapid decalcification of the tarsal bones. It is often of such high degree that one sees only an eggshell appearance in the *x*-ray plate. It appears within two weeks after the operation, when deposition of calcium begins in the gap between the bone fragments. It is an open question whether this decalcification is simply an atrophy of disuse or whether the cancellous bones of the foot are used as a calcium reservoir from which the defect in the shaft of the tibia is replenished. There is also a lesser degree of decalcification in the lower cancellous end of the tibia. One is tempted to assume that the calcium is withdrawn for repair. A physiologist at Northwestern University is attempting to determine the real explanation, but whatever the explanation, the decalcification is a very real difficulty. If one attempts to maintain the position of the foot by pressure, the tarsal bones, particularly the astragalus, are crushed. On the other hand, if the foot is allowed to distort and is later corrected by a subastragaloid arthrodesis, the tarsal bones are easily crushed during this operation. The change usually produced is a flattening of the dome of the astragalus under the tibia, which limits the ankle motion in dorsi- and plantarflexion. If this limitation is not too marked it makes an excellent block for a flail ankle, but it is difficult to control the amount of the limitation. The decalcification disappears with use and, as usual, the arthrodesis produced in these decalcified bones is good.

Nerve disturbance shown by loss of sensation from the lengthening has occurred in two cases. In both it cleared up in about six to eight weeks and in neither was any trophic sore produced. In both these cases lengthening was well over 2 inches.

SUMMARY AND CONCLUSIONS

1. Equalization of leg length by lengthening of the bones of the lower leg is feasible and the equality will be maintained through the period of growth at adolescence in the great majority of cases, at least in poliomyelitis cases. We do not believe the operation is worthwhile in a patient who has not sufficient power to walk without a brace.

2. Equalization of leg length does not improve the gait in poliomyelitis cases unless certain conditions as to muscle power are met. First, the gluteus muscles must have adequate power to fix the pelvis

against gravity when walking. Second, the quadriceps must have enough power to extend the knee against gravity plus several pounds resistance applied to the ankle. Third, if there is any doubt as to whether the gait will be improved by leg lengthening the shoe should be built up an amount equal to the proposed lengthening and the gait observed for a week or two.

3. In view of the difficulties of the operation and after-care we do not believe the operation is worthwhile for less than 1½ inches of shortening.

4. More than 3 inches of lengthening is risky on account of the danger of nerve disturbance.

5. Shortening due to old osteomyelitis we consider an absolute contraindication to leg lengthening because there is danger of lighting up the infection and the bone is of poor quality. Shortening following osteomyelitis is prima facie evidence of poor bone.

6. Congenital shortening is a relative contraindication and each case must be decided upon individually.

7. Shortening due to epiphyseal injury has not maintained the lengthening which may be obtained.

In this study we have tried to be as objective as possible and not to be influenced by parents, patients, interns or nurses. We have noted in our earlier patients that the ones showing the better results were chosen, unknowingly, to fulfill the criteria given above. As these observations formulated themselves and we began to choose knowingly, the results have been more satisfactory, but the series has not grown rapidly. We believe the operation has a field of usefulness within the framework we have outlined.

REGIONAL ILEITIS

RÉSUMÉ OF PRESENT KNOWLEDGE AND THE ADDITION OF TWENTY-TWO CASES FROM BROOME COUNTY, NEW YORK

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CICATRICIAL or regional enteritis is a nonspecific low grade inflammatory process in a localized area of the intestinal tract. It generally affects the terminal ileum but may be found in any part of the intestinal tract.

Reports of cases under various names have been known in literature as early as 1806,[1] but a clear cut description of this clinical entity was not given until 1932.[2] At this time Crohn and his associates gave a comprehensive pathological and clinical description of this disease and differentiated it from other similar conditions. Since then, cases have been reported from all over the world and in all classes and kinds of people. The original concept of a disease limited to the ileum was expanded to include the entire intestinal tract. Regional colitis has been differentiated from this condition by some men[3] but generally the condition is considered the same.

The etiology is obscure. Felsen[4] believes bacillary dysentery the cause. Bargen[6] and writers in general disagree. Stafford[5] suggests that a virus may be the cause. Crohn[7] and Bargen[8] admit the possibility. Bargen[8] and others of the Mayo Clinic[9] despite all negative tests are of the opinion that the condition may be of tuberculous origin. The definition generally accepted is that this is a nonspecific granulomatous condition accompanied by lymphstasis or blocking.

The pathology is that found in nonspecific granulomas and is characterized by an inflammatory reaction in which there is a marked productive element. Ginzburg and Oppenheinmer[10] in a study of nonspecific granulomas of the intestine including ileitis state that histologically a study of all the various types of lesions show "merely evidences of various degrees and stages of acute and chronic inflammation with infiltration by lymphocytes, polymorphonuclear leucocytes, plasma cells and mast cells, together with varying degrees of fibroblastic proliferation and often degenerative changes. In some of the peri-intestinal lesions there is often considerable hyalinization and calcification and even early bone formation has been encountered. The presence of giant cells is a common finding." They believe that these are of only accidental significance and are due to the presence of particles of nonabsorbable vegetable matter which have become incorporated within the lesions as a result of deep ulceration and which act as irritants. Hadfield[11] is the only pathologist found by the writers who claims to be able to identify the specific histological picture of regional ileitis.

The gross appearance depends on the stage when first noted. During the acute process the bowel is edematous, thickened and injected with a rough, easily bleeding, granular serosa, often covered with tubercle-like formations. The mesentery is thickened and contains enlarged but discrete nodes. When sufficiently advanced, the gut feels like a "rubber hose." Areas of normal bowel between sharply defined diseased segments—so-called "skip" areas—may be present. These normal areas may vary from a few inches to several feet. Failure to note these is regarded as a reason for recurrence after adequate complete removal of the diseased segment.[12]

The disease process in the terminal ileum seems to extend into the cecum, but in most cases it ends at the ileocecal junction. However, the cecum may be affected, either by extension of the process or alone. As noted above, the same process may be seen in the jejunum or in the colon or in small bowel and colon at the same time.

Clinically, early cases often have symptoms suggestive of acute appendicitis and the true condition is discovered only at operation for this condition. There is lower abdominal pain, elevated temperature and an increased white blood count. The pain, however, is often diffuse and may even be on the left side. Crohn[7] believes that diarrhea is a constant finding and differentiates this condition from appendicitis.

As the disease progresses, due to interference with the blood and lymphatic supply, ulceration of the mucosa occurs. The breaking down and attempted healing in the bowel cause symptoms of a mild colitis. The healing process may cause scarring with mild obstruction. The diarrhea is less marked than in ulcerative colitis. Recurring bouts of abdominal pain, fever and diarrhea are common. Due to the fibrosis a mass may be felt, usually in the right lower quadrant. The distortion and rigidity of the bowel due to the scarring causes a constant defect in the *x*-ray film which has been labeled the "string" sign by Kantor. This is considered to be pathognomonic of ileitis when present.

The next stage is that of advanced scarring with signs and symptoms of intestinal obstruction. The bowel is leathery and the wall thick and fixed. The mesentery is thick and rigid. Severe cramps, nausea and vomiting are noted clinically. An abdominal mass is usually present. *X*-ray examination shows a dilated small bowel above an area of obstruction.

The last stage is characterized by the development of multiple sinuses and fistulas between the various loops of bowel and between the bowel and the outside. Fecal fistula following appendectomy is one of the pathognomonic signs of a residual ileitis. Crohn[4] reports fistulous tracts to the inguinal region, lateral abdominal wall, right lumbar and perianal regions. Rectal and rectovaginal fistulas are sometimes seen. Due to the slow perforation, abscesses may be found walled off by the surrounding bowel. The omentum is thickened and granular and seems plastered to the adjacent viscera. The process may be so widespread that exact delineation of the pathological process may not be possible. The bowel is markedly thickened and of a leathery texture.

In the advanced cases aside from those with abscess formation a short circuiting procedure with section of the ileum will cause the acute process to subside. At the second operation the pathological appearance will be entirely different. The disease process will then be seen to involve a comparatively short segment, usually the terminal ileum. The rest of the intestinal tract will seem normal. Even the omentum will have regained a fairly normal appearance and can be freed with comparative ease from the adhering bowel. The involved segment will have a leathery appearance and will have lost its acutely inflamed look. It is usually quite rigid and fixed to the underlying thickened mesentery. In the lumen due to the alternate breaking down and healing process the intervening uninvolved mucosa is thrown into prominence giving the mucosa a cobble-stone appearance which is characteristic.

The writers would like to emphasize with Crohn that the pathological process does not necessarily conform to the clinical picture. The process may be slow with immediate healing causing obstruction with little or no acute inflammatory changes noted grossly. On the other hand an acute onset may usher in the last stage of an ulcerative or obstructive lesion with abscess formation. Thus while the acute type may usually be considered not

to show the advanced lesions, occasionally at operation for an acute abdomen a definite peritonitis with an advanced stage of ileitis with perforation into the general abdominal cavity may be found. Marshall[13] and Querna[14] each report a case of general peritonitis following perforation with fatal outcomes.

DIAGNOSIS

The diagnosis of ileitis should always be considered in a young patient with recurring attacks of abdominal pain, diarrhea and loss of weight. Also in cases of chronic partial intestinal obstruction accompanied by signs of a low grade inflammatory process. The presence of diarrhea according to Crohn[7] definitely rules out acute appendicitis. From personal experience we differ with him on that point. However, recurring attacks of abdominal pain and diarrhea accompanied by loss of weight, slight fever, leukocytosis and anemia in a young individual should lead one to look for ileitis in the absence of a definite ulcerative colitis. The presence of a mass in the right lower quadrant is highly suggestive when present. Fecal fistula following an appendectomy is another highly suggestive finding. It is in these cases that the *x*-ray examination will demonstrate the rigid terminal ileum usually in the form of the "string-sign" of Kantor. According to Brown, Bargen and Weber[15] the *x*-ray is the chief diagnostic aid.

The differential diagnosis is easy according to Crohn.[7] He believes that with the exception of primary ileocecal tuberculosis, which is practically nonexistent, a careful history and *x*-ray and sigmoidoscopic examination will demonstrate the disease when present. Other writers, including ourselves, are not so optimistic. Brown, Bargen and Weber reported eighteen cases from the Mayo Clinic in 1934 with the following preoperative diagnoses: Inflammatory lesion of the bowel, eight; undetermined type of obstruction of bowel, eight; carcinoma, one; cholecystitis, one. Cutler[16] mentions a case which was classified as regional enteritis for two years before the true diagnosis of carcinoma was made. Two cases which were carefully studied in our hospital, one of which had a typical "string-sign," turned out to have appendiceal pathology only. In our experience and that of most of the writers on the subject, the condition was often first noted at operation.

TREATMENT

The treatment of regional ileitis is considered surgical at the present time. Dr. Elliott Cutler, Professor of Surgery at Harvard University, disagrees. He states that in his experience and that of his colleagues, surgery has been of little value, except when signs of obstruction or abscess presented. He questions the reliability of the cures reported by the advocates of surgery and believes he can get the same or better results by medical treatment.[16] Crohn[12] answers this by stating that when the disease has progressed to definite scarring, the bowel is permanently damaged even though clinically the patient is well. If this is not remedied, there will be future trouble. He reports one case demonstrating this point. Marshall[13] agrees with this concept.

Both Crohn and Cutler agree that medical treatment should be used in acute cases, and in those which are too far advanced for radical surgery.

The medical treatment suggested by Cutler and which is generally used, consists of a bland diet containing a high protein, high vitamin and low residue content. Mineral oil is suggested. The use of supportive measures such as blood transfusions, alpine light, bed rest, etc., are used as indicated. Crohn experimented with the use of typhoid and other nonspecific therapy without success.[12] *X*-ray therapy is also advocated by Cutler in some cases. The writer has used it in one case without much success.

The surgical treatment is still being debated. Acute conditions found at operation should be left alone unless obstruction

exists. In this case an ileocolostomy or even enterostomy as reported by Kross[17] may be indicated. In the presence of perforation or signs of peritonitis or abscess formation simple drainage is advocated. The use of more complicated procedures results in a high mortality.[13,14]

The treatment of the appendix in cases of acute ileitis is debatable. Fecal fistulas following appendectomy are reported in nearly all series. On the other hand, simple appendectomies with cure are also reported in the same series. The exact percentage of fecal fistula compared to the total number of cases with appendectomy only is not known, but from the series we surveyed, the percentage is fairly high.

Ileocolostomy with section of the terminal ileum was originally advocated as the first step of a radical resection. The same procedure without transection of the ileum has been found to be unsatisfactory due to the fact that the diseased segment is not put at rest. As a result progression occurs making the next step difficult if not impossible. Pemberton and Brown[18] report six of eight patients with ileocolostomy only as well two to five years later. Colp and Ginzburg[12] report twenty-two cases with this procedure only with twenty clinical cures. The remaining two cases had fecal fistulas and they emphasize that in this type resection must be done later. Ileotransverse colostomy by the side-to-side technic is generally employed. The position of the ileum as regards iso- or antiperistalsis is unimportant. Ileosigmoidostomy may be used if a normal bowel cannot be found proximally.

Radical resection is at present the most widely used. This may be done in one or two stages. The first stage may be an ileocolostomy or as advised by Marshall of the Lahey Clinic, resection by the Mikulicz procedure as modified by Lahey. In this the mass is removed at the first stage leaving a double-barreled colostomy opening with the ileum longer than the colon spur. A tube is immediately inserted into the ileum. Later the spur is crushed and the patient sent home. Repair of the colostomy is done several weeks later. Primary resection with immediate anastomosis is employed frequently. The series from the larger centers show a preponderance of this procedure.

RESULTS

Radical surgery is attended with a mortality of about 15 per cent.[12] Recent reports from the larger clinics have bettered this. Marshall reports resection of the affected loop in twenty-two patients without a fatality. Seventeen of these patients were operated upon by the modified Mikulicz procedure. In four additional cases ileocolostomy alone was done with one fatality and in three others drainage of abscesses was accompanied by one fatality. This gives a total of twenty-nine cases with two deaths. Clark and Dixon[9] report forty-four cases of which fourteen had an ileocolostomy with four deaths; fourteen patients had a one-stage resection with one death, fifteen had a two-stage resection with two deaths and one had a simple exploration and recovered. Blackburn[20] and his associates report sixteen one-stage and four two-stage resections without mortality. Two other cases had short circuitating procedures with equally good results.

Crohn has advocated radical resection believing that about 50 per cent of the palliative procedures are followed by recurrence. Recently he has swung to the conservative side and feels that ileotransverse colostomy should be performed, as advocated by Colp and Ginzburg.[19] He attributes the high mortality reported to the fact that cases are seen after extensive involvement has occurred or after delay in resorting to surgery.

The recurrence rate quoted by Crohn is 7.7 per cent. This is ascribed to too conservative resections. He contends that the amount of bowel remaining is immaterial as far as ability to live normally. Marshall reports two recurrences in his twenty-nine cases. Blackburn[20] in twenty-two cases reports no recurrences.

Crohn[12] states that there is a 90 per cent return to health when the proper surgery is used. This seems borne out by the results quoted above. The discrepancy between this and the statement of Dr. Cutler of practically no cure lies in the method of interpreting the patient's clinical status. Crohn[7] relies on the fact that the patient has gained weight and is able to carry on his occupation. Cutler[16] makes use of the *x*-ray interpretation by the "motility" series and classifies only as cured that rare case which has absolutely no intestinal symptoms and a completely normal gastrointestinal tract as evidenced by careful examination.

REGIONAL ILEITIS IN BROOME COUNTY, NEW YORK

This study comprises twenty-two cases of regional ileitis which have been found in the records of the Binghamton City Hospital (565 beds) (seventeen cases), The Wilson Memorial Hospital, Johnson City, New York (328 beds) (three cases), The Ideal Hospital, Endicott, New York (116 beds) (no cases), and from Our Lady of Lourdes Hospital (seventy-nine beds) (two cases). They total a hospital capacity of 1,088 beds and are located in the City of Binghamton, Towns of Johnson City and Endicott, New York. These hospitals supply a population of about 155,000 composed of both urban and rural districts.

The classification used by Cutler[16] and Mixter,[21] which considers the condition the same no matter in what part of the intestinal tract it occurred, was used.

Many of the cases were questionable from the pathological viewpoint and have been included only after careful analysis. In many cases the opinion of Dr. Burrill Crohn gave the correct diagnosis. The pathological picture was often not characteristic and only found at later resections. In other words, Homans and Hass'[22] statement of ileitis being a clinical and not a pathological entity seems justified according to this series.

The twenty-two cases were admitted in the following years: one in 1930; one in 1933; one in 1935; six in 1936; five in 1937; two in 1938; five in 1939 and one in 1940.

The age grouping falls within the range quoted in literature. There were nine males and five females in the resected groups. There were four males and four females in the group in which simple appendectomy or exploration only was performed. The total in the group was thirteen males and nine females.

When originally described in the early reports it was stated that regional ileitis had a prediliction for the Hebrew race. Recent literature, however, has demonstrated that this is a fallacy and that the disease may occur in any race and in any class of people. There were no Jewish patients in our entire series.

Fourteen of the twenty-two cases had resections of the bowel. The other eight had either simple appendectomy or drainage.

The nonresected cases were diagnosed in the last four year period (1936 to 1940 inclusive). This suggests that the condition has been looked for with any thoroughness only during that period. It also indicates that similar cases probably were present in other years and not noted. Since the occurrence of persistent fecal fistula during this and previous years was not found, the writers draw the conclusion that acute cases of regional ileitis had best be left alone as they will subside spontaneously. Ginzburg[23] has emphasized this point in a recent paper.

The eight nonresected cases had no treatment directed to the ileitis (Cases xv to xxii inclusive). These were all acute and found unexpectedly at operation. Only one (Case xxi) had diarrhea which is contrary to the history to be expected in ileitis according to Crohn.[7] Six had simple appendectomy without drainage. One (Case xxi) had freeing of adhesions about the cecum due to a previous appendectomy and one (Case xv) had drainage of the peritoneum without appendectomy. The last two showed signs of acute peritonitis.

Cultures of the peritoneum were not done. All of these have recovered and are clinically cured. Since the longest period elapsed is four years, there is a possibility that there may be active involvement at a future date. Case XVIII which showed extreme thickening of the terminal eighteen inches of the ileum in a four year old child would seem to be the best candidate for recurrence since only two years have elapsed since operation. A gastrointestinal series was negative during the hospital period but since we do not use the "motility" series declared necessary by Cutler[16] it is probable that the condition was still present on discharge. It is inconceivable that the amount of pathology found at operation would completely disappear in a few days.

The removal of the appendix in the six acute cases did not result in formation of fistulas which is again contrary to what is generally believed. It seems to the writers that removal of a probable future offender, the appendix, is better for the patient than failure to do so in order to prevent a possible fistula. Our cases and others[24] reported in literature would tend to substantiate this.

There were fourteen cases which underwent radical resection in one or more stages. Four of these had appendectomy without fistula formation before the condition was recognized. One of these (Case IV) had an appendectomy three years before. The involvement of the ileum was noted at the time and considered to be tuberculous. This was an advanced case according to the writer's concept of the condition at this time. The case was not acute and we believe with Crohn that surgery directed to the ileum was indicated at that time. Cases II, X and XI also had appendectomies, two, one and three years, respectively, before resection. Apparently nothing abnormal was noted in the ileum at the time in any of these. The condition found at the secondary procedures was far advanced with marked obstruction necessitating radical surgery in each case. Case II had an ileocolostomy without section of the ileum followed by removal of the terminal ileum, cecum and ascending colon. A supravaginal hysterectomy and salpingectomy were done at the same time. Clinical cure resulted. Case IV had an ileocecostomy, ileosigmoidostomy, resection of ileum, cecum and ascending colon with permanent colostomy, freeing of pelvic colon, permanent ileostomy and ileotransverse colostomy with later development of a fecal fistula in sequence. The result is a bedridden patient. The outlook seems hopeless for clinical recovery. Case X had a resection of the affected ileum with recurrence necessitating further resection. He is clinically improved but not cured. Case XI had a resection of the terminal ileum and cecum and died of a cerebral accident six days postoperatively. At operation a fistula between the ileum and the ascending colon was found. The diagnosis at the time of operation was carcinoma.

In summary, one patient died (Case XI), one is an invalid (Case IV) and one (Case X) after two radical resections must still be considered to have the condition still active. Only one patient (Case II) may be considered to be clinically cured. These cases strongly indicate the necessity for differentiating the "acute" cases which will spontaneously regress from those which have reached the scarring irreversible stage and in which immediate surgery is indicated to prevent the sad results listed above. We are of the opinion that a primary ileocolostomy with exclusion might have improved the results. Radical resection was apparently either inadequate or performed too late.

Two cases (Cases VII and IX) had appendectomy with fistula formation. Repeated attempts were made to close these without success. The explanation given by Ginzburg[23] that the fistula is due to an ulcerative process in the bowel wall which will not close as will the cases due to back pressure following appendicitis is well borne out. Case VII had jejunal involvement at the second radical operation necessitating re-

section of jejunum as well as ileum and colon. He also had an ischiorectal fistula which may well have been a peri-anal sinus from the affected bowel. Case IX had thirteen operations before clinical cure was obtained. Most of these were attempts at closure of the fistula. Finally the terminal ileum, cecum, ascending colon and part of the transverse colon were removed. His last hospital stay was for a period of three years. Healing was not obtained until after the radical resection. This corroborates the findings of Colp and Ginzburg[19] of the necessity for radical resection in cases of abdominal fistula. One of the above patients has apparently been completely cured (Case IX). The other patient (Case VII) is clinically well but may be classified as "disease present and still active." He has occasional abdominal upsets and has to watch his diet carefully.

One patient (Case VI) was operated upon during the abscess stage and was treated by enterostomy and drainage with subsequent drainage of further abscesses as they developed. Later radical resection of the ileum, cecum and ascending colon resulted in a clinical cure.

Another (Case VIII) had involvement of the sigmoid only and was treated by exteriorization and resection with subsequent closure of the colostomy. At the time of the operation the condition was considered to be malignant. The patient is clinically well.

Four cases (I, V, X and XIV) were treated by radical resections of the ileum only with immediate anastomosis as the primary procedure. Case X only had had a previous appendectomy. As mentioned before, recurrence occurred necessitating further removal of ileum but without touching the cecum. Case I had a primary resection of the ileum with a clinical cure. He has occasional abdominal distress but the gastrointestinal series have been negative. Case V had a primary resection of the ileum during the acute stage with generalized peritonitis, resulting in an operating room fatality. In the light of literature and Cases XV and XXI in our series simple drainage might have changed the outcome. Case XIV had resection of the terminal ileum and ileocolostomy with clinical cure.

The three surviving cases substantiate Mixter's[21] statement that removal of the cecum is not necessary unless it is affected, as long as a fairly large area of normal small bowel is left at each end of the diseased area. The recurrence (Case X) was due to failure to remove mesenteric glands attached to underlying large blood vessels.

Crohn believes that resections should always include the cecum if the ileum near it is involved. The above questions this statement.

Three cases (III, XII and XIII) had radical resections of terminal ileum, cecum and part of the ascending colon without previous operative procedures. In two (XII and XIII) the condition was not suspected, the diagnosis being appendiceal abscess and ectopic pregnancy, respectively. The other (Case III) had a typical history of ileitis with diarrhea, loss of weight, etc., and was not admitted as an emergency. She died following a second operation for intestinal obstruction which developed postoperatively. The complication of intestinal obstruction following intestinal resection is one of the reasons given by Colp and Ginzburg[19] in advocating ileocolostomy. Cases XII and XIII are clinically cured. Proximal enterostomy was done in Cases III and XIII.

In summary, two cases (II and IV) had preliminary short circuiting operations followed by radical resections. One (Case VI) had drainage of abscesses and ileostomy with later resection. One case (VIII) had a Mikulicz procedure. Ten cases (I, III, V, VII, IX, X, XI, XII, XIII and XIV) had radical resections in one stage.

Mortality. There were no deaths in those having a two-stage or Mikulicz operation. There were three deaths in the ten primary rections giving a mortality of 27 per cent. The total mortality for the resected cases (14) was 21 plus per cent. The mortality for the entire series of twenty-two cases was 13.6 per cent.

A survey of the above shows definitely that while primary resections if radical

enough will give the best results, the mortality is prohibitive in the average surgeon's hands. That this applies generally may be noted by comparing this report with that of T. H. Russell from the Post-Graduate Hospital in New York City listing twenty-seven cases of which eleven had appendectomy only with three deaths.[25]

clinically well for about four years before a second operation was necessitated by obstruction. Following this procedure he has remained well to date—six years.

Three other cases (IV, VII, IX) had multiple operations but none of these was ever well between the various procedures. Case IV was undoubtedly inoperable when radi-

REGIONAL ILEITIS
BROOME COUNTY, NEW YORK

Case*	Age	Year	Procedure	Abdominal Fistula	Recurrence	Clinical Result
I	49	1937	Primary resection	o	No	Cured
II	44	1936	Stage resection	o	No	Cured
III	19	1936	Primary resection	o	.....	Died
IV	22	1937	Stage resection, multiple operations	o	Yes ?	Surgical failure
V	17	1936	Primary resection	o	.....	Died
VI	33	1936	2 stage resection	o	No	Cured
VII	26	1933	Primary resection	Yes	Yes ?	Improved
VIII	47	1936	Mikulicz' procedure	o	No	Cured
IX	34	1935	Primary resection	Yes	Yes ?	Cured
X	22	1930	Primary resection	o	Yes	Improved
XI	57	1939	Primary resection	o	.....	Died
XII	21	1939	Primary resection	o	No	Cured
XIII	27	1938	Primary resection	o	No	Cured
XIV	12	1939	Primary resection	o	No	Cured
XV	38	1937	Drainage	o	No	Cured
XVI	14	1936	Appendectomy	o	No	Cured
XVII	17	1935	Appendectomy	o	No	Cured
XVIII	4	1938	Appendectomy	o	No	Cured
XIX	55	1937	Appendectomy	o	No	Cured
XX	19	1939	Appendectomy	o	No	Cured
XXI	60	1939	Freeing of adhesions	o	No	Cured
XXII	15	1940	Appendectomy	o	No	Cured

Total: Appendectomies	6
Drainage	1
Freeing of adhesions	1
Resections	14
Recurrences	4
Results: Clinically cured	16
Improved	2
Surgical failure	1
Deaths	3

* These patients were operated upon by Doctors Bowen, Cunningham, Dyer, Henry, Hobbs, W. T. King, H. J. King, Matthews, Molyneaux, Moore, Pope, Squires, Sneierson, Torrance and Whittemore (deceased).

There were four recurrences in the fourteen resections. If one classifies as recurrence those cases which after operation are clinically cured for a varying period, only one in our series was a true recurrence (Case X). In this case the mesenteric glands were so enlarged and adherent to the underlying large vessels that they were not removed at the first operation. He was

cal resection was attempted. Cases VII and IX had fecal fistulas after appendectomy and these were present during the entire operative course until complete healing and clinical cure resulted. These should be classified as extensions due to inadequate primary surgery and not as true recurrences since the focus was not removed originally. These cases indicate that resec-

tion must be radical and thorough to be of lasting value. One case (VII) required jejunal resection at one of the later procedures and it is possible that this "proximal minimal" lesion was present at the original operation as suggested by Colp and Ginzburg[19] and was not a recurrence.

SUMMARY

1. A brief résumé of the literature on regional ileitis including the pathological and clinical picture of this entity has been presented.

2. The conflicting opinions of various authorities as to etiology, pathology and treatment have been presented.

3. Twenty-two cases from Broome County, New York, have been reported and discussed.

4. The conclusions of the writers are that: (a) Regional ileitis or cicatrizing enteritis is a clinical rather than a pathological entity and is the same no matter what part of the intestinal tract is affected. (b) Acute cases found inadvertently at operation had best be left alone or if obstruction is present a short circuiting operation with section of the ileum performed. Routine appendectomy is safe unless radical resection is planned at a later date. (c) Radical resections especially in one stage carry a prohibitive mortality in the hands of the average surgeon. When indicated a two-stage procedure is safer, either by previous ileocolic anastomosis with section of the ileum or by the Mikulicz procedure as advocated by the Lahey Clinic. (d) Ileocolostomy with exclusion seems to be the best procedure to date except in cases with abdominal fistulas. In these cases radical resection in two stages seem safer.

We wish to acknowledge our indebtedness to Dr. Burrill B. Crohn for his encouragement and assistance in the preparation of our case reports and to Dr. Victor W. Bergstrom for his invaluable aid in preparing the pathological reports.

Thanks are also due to the various hospitals and their staffs for their co-operation and permission to use their case reports.

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THE MANAGEMENT OF SCOLIOSIS*

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THIS article is prompted by the frequently heard statement, "You can't do anything for scoliosis anyway." It is a plea for the recognition of the fact that scoliosis can be effectively treated, and should be treated for the physical and mental well being of the patient.

ETIOLOGY

It is obvious that a causative factor should be determined. Its importance cannot be overemphasized, as it determines both the prognosis and the treatment. In this report we are not considering the functional curve from short leg length and faulty posture, or the temporary curve caused by muscle spasm.

Paralytic. At the Oklahoma Crippled Children's Hospital, poliomyelitis is the commonest cause of scoliosis. These curves may be caused by either back, abdominal, hip or shoulder girdle paralysis. They are usually progressive and may get worse through adult life. The resulting deformity is often extreme and may be incompatible with life. Without exception every case with asymmetrical trunk paralysis will develop a scoliosis. On the other hand, those with symmetrical paralysis usually do not develop a scoliosis. Extensive paralysis may result in double primary curves, greatly complicating the picture. High dorsal curves cause marked chest deformities with decided reduction in vital capacity. This one factor alone may make an invalid of the patient and predispose to fatal pneumonia, etc. The severe rib deformity causes a grotesque appearance which is embarrassing to the patient who is often unwilling to appear in public. On the other hand, the lumbar type of curve, usually resulting from abdominal muscle paralysis, seldom causes much respiratory embarrassment. Many of these patients will, however, suffer from tilting of the pelvis with resultant apparent disproportion in leg length and loss of balance. They may not be able to stand or sit erect.

Idiopathic. Most of this group are husky, well developed girls between the ages of ten and fifteen. Ninety per cent of these curves are midright dorsal. No muscle imbalance is found. The curves usually start insidiously without a history of significant illness or familial tendency. We have only two instances in which two members of the same family had idiopathic scoliosis. The old theory that these curves were due to carrying heavy school books has been generally discarded. However, the similarity in habitus and the frequently associated menstrual disorders probably indicate the presence of an endocrine factor. The curve does not progress after the cessation of growth.

Thoracogenic. 1. *Empyema:* This curve is caused by the glueing together of two or more ribs by scar tissue, with continued growth of the opposite side, forming a curve with the concavity toward the lesion. Therefore, these curves also do not progress after cessation of growth. The severity of the deformity depends upon the age of onset. All children with chronic empyema should be closely watched for scoliosis.

2. *Tuberculosis.* Many patients with unilateral fibrous tuberculosis of the lung develop mild curves which seldom progress. However, following thorocoplasty practically all patients develop a scoliosis with the convexity toward the lesion. In adults these curves are usually mild and self-limited. In children they are nearly always severe and progressive.

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Congenital. These curves are usually noticed in early infancy. They are short and sharp with long and usually inadequate compensatory curves. There frequently is a demonstrable hemivertebrae or other congenital anomalies of the spine or ribs and the curves seldom progress. The appearance of the patient often becomes worse with growth, however, because the deformity is magnified.

Neuropathic scoliosis usually develops very rapidly with long severe curves. Scoliosis may develop with syringomyelia, cord tumors, von Recklinghausen's disease, cerebrospastic quadriplegia, hydrocephalus, spina bifida, etc.

There are many other causes of scoliosis such as vertebral epiphysitis, myositis ossificans, rickets, fractures, etc., but they are relatively rare and require treatment of the primary condition.

It should be remembered that two or more conditions may occur simultaneously. For example, we have under observation a patient with poliomyelitis with a congenital scoliosis, and another that was treated for idiopathic scoliosis before the onset of her poliomyelitis. It is obvious that a careful history and physical examination are essential, but in spite of careful examination and repeated roentgenograms we have been unable to classify five cases.

TREATMENT

The treatment of scoliosis depends on progression of the curve, imbalance, deformity and pain. The latter, surprisingly enough, is rather rare. Occasionally, the patient with a high dorsal curve will have pain due to impingement of the scapula on the angulated ribs. In one of our cases the scapula would sometimes be caught against the ribs so that the patient was temporarily unable to raise his arm. In this case rib resection was indicated.

1. The postpolio scoliosis presents the most difficult problem. High dorsal curves receive no support whatever from the usual type of brace, plaster or celluloid jacket. Despite improvement in appearance, roentgenograms taken with the brace on will show that the curve is not being supported. *If the curve was progressing before the application of the brace, it will continue to do so after the brace has been applied.* Therefore, one should first determine whether the curve is progressing. This can best be done by making standing films at two to three month intervals. If the spine is mobile, the curve will probably progress. If it is stiff, it will probably not progress although this is not always so. The lumbar curve lends itself much better to some sort of support. Celluloid jackets, plaster corsets, or a Barr type of adjustable brace, may prevent progression of the curve. However, the support will probably have to be worn for many years until Nature herself stiffens the curve. When lateral abdominal paralysis is present, the instability of the patient may be greatly improved by a Lowman transplant and deformity may be prevented. But this procedure will not stop progression of an already formed curve. As in the transplant of tendons in the paralytic foot, it serves to balance but will not stabilize. Most of these patients will ultimately need fusion if a severe deformity is to be prevented. It has been said that the stiffening of a spine by fusion is unphysiological but any primary curve in a patient over thirty becomes stiff anyway. The best time to treat the polio back is before the curve starts. No patient with back or abdominal muscle weakness should be allowed to sit up without adequate support. Usually long support in plaster in recumbency is necessary.

2. The idiopathic curve presents an entirely different problem. If the patient is young and the curve progressing rapidly, correction and fusion is the method of choice. But, if the patient is fifteen or sixteen and a comparison of her height with that of other members of the family suggests that she has about attained her growth, simple support is all that is necessary. It will probably not have to be continued for more than a year or two and

Fig. 1.

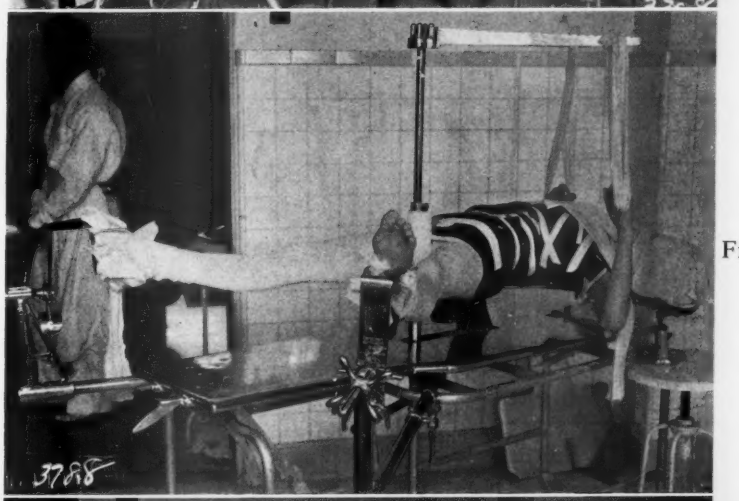

Fig. 2.

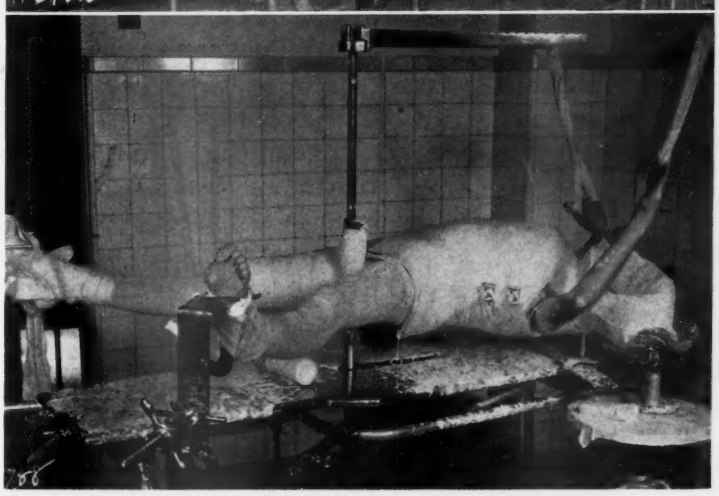

Fig. 3.

Fig. 1. Attachment used on Hawley table with irons bent to fit patient.

Fig. 2. Patient with padding applied.

Fig. 3. Same. Plaster extends to right knee on convex side of primary curve.

no further deformity will result. But, this method is merely supportive not corrective. The important thing about this type of curve is that a majority of these cases stop progressing *before cessation of growth.* It should, therefore, be emphasized that supportive treatment should not be used until there is roentgenographic evidence of progression of the curve. Otherwise, the patient is loaded down with much useless paraphernalia which may well be detrimental to health as well as being a nuisance. Back and abdominal muscle exercises and physiotherapy will keep these patients occupied until progression can be determined. Because the curve is usually middorsal, braces are of no use unless they extend up under the chin and occiput. This makes a very heavy, cumbersome appliance. Celluloid jackets, or light plaster jackets, extended over the shoulders, provide the best means of support. When a celluloid jacket is applied, the use of the Murk-Jansen plaster bed at night may help to maintain correction. Models for the celluloid jackets are made with the patient in suspension and therefore some correction is obtained. Similarly, a Murk-Jansen bed is convex and the patient lies on it on the convex side of her curve thus allowing her weight to aid in the correction.

Fig. 4, Case J. D. Age 13. Idiopathic scoliosis. Preoperative photograph.

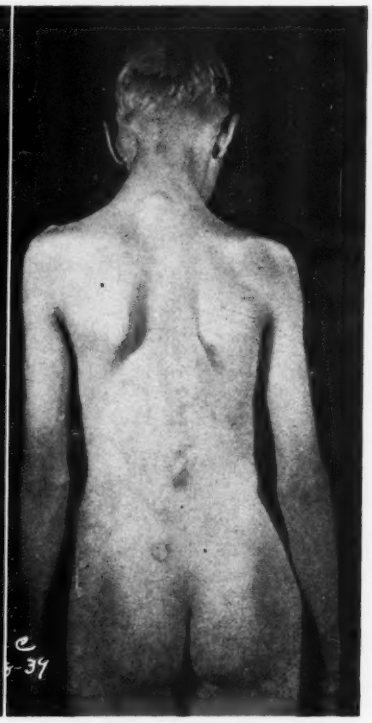

Fig. 5. Case J. D. Twenty six months postoperative.

3. Scoliosis occurring because of chronic empyema in young children should be treated by fusion, as the curve will progress even in a plaster support. If the patient is close to the end of the normal growth period (usually sixteen years for girls and seventeen years for boys), no treatment is necessary for prevention of deformity. Cosmetic improvement is best obtained by resection of the affected ribs, followed in two to three weeks by the application of a plaster jacket with correction and fusion in the usual manner.

Scoliosis in tuberculous adults, with or without thorocoplasty, usually does not require treatment. In children following thorocoplasty spine fusion is nearly always necessary because of rapidly increasing scoliosis. Fusion should not await the

development of a severe deformity. Correction in the usual manner should be instituted early. However, it is usually best to do these operations under local anesthesia.

Fig. 6. Case J. D. Preoperative standing roentgenogram 108′.

Fig. 7. Case J. D. Thirteen months postoperative standing roentgenogram 45′. Notice the change in the rib interspaces.

4. Congenital scoliosis is seldom progressive and therefore, in most cases, no treatment is indicated. However, the patient should have roentgenograms at regular intervals to be sure that there is no progression. If the curve increases, spine fusion is indicated. Where the curve is high and severe deformity is present because of rib rotation, a partial resection of the affected ribs may give a much improved appearance. This should not be done if the vital capacity is low because respiration may be seriously embarrassed.

5. Neuropathic scoliosis is usually corrected by removal of the underlying pathology. In the spastic child, muscle training and postural exercises are usually sufficient. When the underlying pathology is progressive, fusion is of little avail. Adequate support may, however, prevent severe deformity.

Occasionally adults with clinically stiff curves have pain due to arthritic changes or nerve root compression. Fusion may be necessary and should be done without attempting correction.

That scoliosis is a common condition is shown by the fact that in a period of only one year (August, 1938 to August, 1939) 174 new patients registered at the scoliosis clinic of the Crippled Children's Hospital. Table I shows the distribution of these cases. Of these 174 cases, forty-one or 23½ per cent were fused as is shown in Table II.

Table I

Poliomyelitis	103
Idiopathic	34
Empyema	4
Congenital	9
Neuropathic	9
Others	15
	174

Table II

Poliomyelitis	24
Idiopathic	11
Empyema	2
Vertebral—	
Epiphysitis	2
Others	2
	41

Many more of the polio cases now need, or ultimately will need, fusion for prevention of deformity. The relatively large number of idiopathic cases fused is accounted for by the fact that many of these girls wanted correction for cosmetic reasons. In spite of the fact that it was explained to them that there would be no further increase in their deformities, they

insisted on correction and fusion for improvement in their appearance.

In addition to improvement in appearance following fusion because of lessened deformity and better balance, there is usually a considerable increase in the patient's height. We have one case with eleven inches and another with seven and one-half inches increase in spine length in patients past the growth period.

Fig. 8. Case L. G. Patient with empyema when scoliosis was first noticed at the age of seven.

Fig. 9. Case L. G. Preoperative photograph at the age of fifteen.

The primary curve is usually the middle one of three curves, is less moveable than the compensatory curves and of a greater degree. The extent of the primary curve is measured as follows: Lines drawn across the top of the vertebrae will form radii of a circle. As soon as they form the radii of a new circle the extremes of the primary curve have been reached. This primary area must be included in the fusion or the curve will continue to progress. In the normal spine the top and bottom of all the vertebrae are parallel to one another. Therefore, perpendiculars dropped through the lines at the ends of the primary curve will measure the deviation from the normal.

If fusion is decided upon for any of the above listed reasons the mobility of the primary and secondary curves should be determined. We do this by taking supine roentgenograms while the back is being forcibly bent, both to the right and to the left. This is done by attempting to approximate the head to the knee. One film will then show the maximum motion in the compensatory curves, the all important factor in balance. The other film will show the probably obtainable correction in the primary curve. In plaster, usually about twenty degrees more correction can be obtained than on the bending film. If the primary curve does not straighten considerably, there is no point in applying the turnbuckle jacket.

When correction is decided upon, every effort is made to build up the patient by a vigorous regime of sunshine (or ultraviolet light) and exercises. The patient is then admitted to the hospital and the Risser type of jacket is used with certain modifi-

cations. First, the jacket is applied with the patient in maximum bending toward the concave side of the primary curve. This accomplishes three things: (1) the compensatory curves are straightened and the spine converted into one long curve; (2) the compensatory curves thus derotate and it is a fact that the primary curve also derotates as a unit, possibly because of its stiffness; (3) the patient is straighter and therefore more comfortable after correction. Correction is then obtained with hinges and turnbuckles.

Figure 1 shows a simple attachment for the Hawley table, consisting of two malleable steel bars, a plate through which they fit, and a "Y" piece. The bars are bent to fit the maximum bending of the patient. Padding is then applied as shown in Figure 2 and the plaster wrapped on. (Fig. 3.) The hinges may either be applied at the same time or the next day. They are place eccentrically at the apex of what is now a single curve in order to obtain some distraction. Several days are allowed for drying and the plaster is cut and wedging begun. Usually only one leg, the one on the convex side of the primary curve, is included in the plaster. But if there is much paralysis about the hips it is better to include both legs to the knees or toes to prevent slipping of the pelvis.

Unfortunately, the wedging jacket allows correction in only one plane, but because of rotation ideal correction is in two planes. Therefore, after correction a second modification of the usual technic is employed. Taking great care not to lose any of the correction, the hinges and turnbuckles are removed and the upper part of the cast is rotated as far as possible so as to bring the shoulder on the convex side of the primary curve forward. This accomplishes two things: First, the rib deformity, or razor back, is lessened; second, the operation is greatly simplified. Formerly in many of the cases with severe deformity the spinous processes lay almost parallel to the table. This made exposure very difficult. Since the derotation method has been used, the spinous processes have been vertical in almost every case. Many patients want fusion for cosmetic reasons

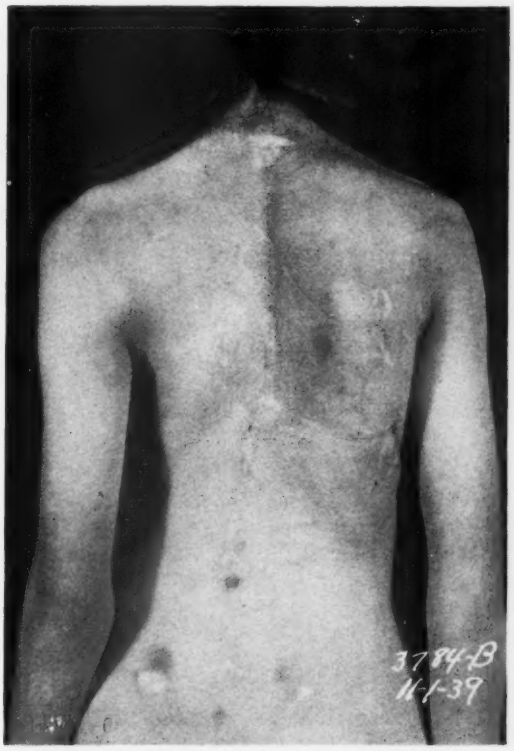

Fig. 10. Case L. G. Fourteen months postoperative.

and this maneuver gives them a much more satisfactory result. Of course, in long standing cases some of the rotation may be due to deformity of the vertebra itself which obviously cannot be corrected by this method. These cases usually also have a fixed rib deformity. They are greatly benefited by partial thorocoplasty along with the fusion. The rib fragments make excellent additional bone and the operative risk does not seem to be materially increased.

The primary curve must be included in the fusion area or deformity will recur. The fusion area should be between parallel vertebrae in order to maintain balance. When a spine is fused that area is, in effect, made into one vertebra. In a normal spine the top and bottom of each vertebra are parallel in order to maintain balance. We strive to obtain the same condition with fusion. The fusion area is determined from the *immediately preoperative corrected x-ray*

and not from the original film. Therefore, the more correction obtained, the fewer vertebrae will be fused. The back of the plaster is then cut out and the patient operated upon by the modified Hibbs or Mackenzie Forbes technic. Six or sometimes seven vertebrae are fused at a time. Additional tibial bone in the form of small chips from the ilium, tibia, ribs or transverse processes is always used.

Fig. 11. Case D. L. Preoperative photograph.

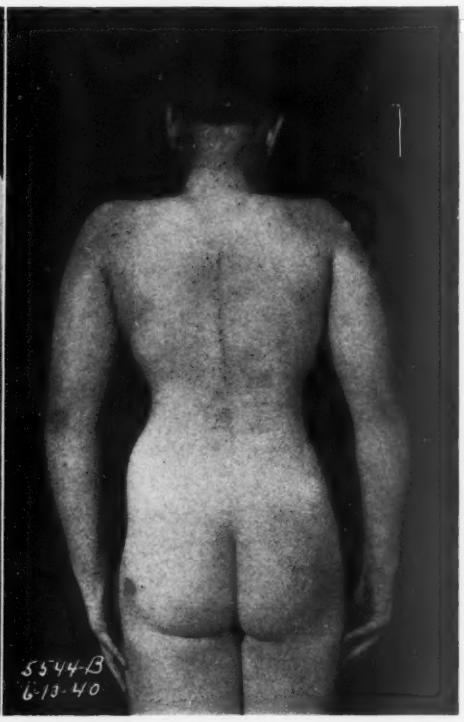

Fig. 12. Case D. L. Nineteen months postoperative.

It seems logical to fuse the lowest part of the curve first because, (1) this area is subject to the greatest strain, and therefore, (2) almost all pseudarthroses occur in this area (from D11 down); (3) when the fusion is started low it can usually be carried across the danger zone in one stage thus avoiding joining at an already weak point; and (4) this usually weak area will be held in plaster at least one month longer than the subsequent fusion area.

For two weeks preceding the operation the patient is given large quantities of stick candy and orange juice to build up the glycogen reserve and increase the vitamin C content of the body. A continuous infusion of saline and glucose is started with the anesthesia and is continued to 3,500 or 4,500 cc. depending upon the size of the patient. Postoperatively the foot of the bed is elevated for twenty-four hours. Cyclopropane is the usual anesthesia but a few cases (one with vital capacity 15 per cent of normal) have been done under regional block. There were no postoperative complications in any of these patients.

The patient remains in the original plaster for three or four months after the last operation, depending upon the amount of force necessary to correct the curve. A second plaster is then applied in recumbency without attempting to straighten the patient for another three months and the patient is allowed to get up. Plaster corsets are then applied at two or three month intervals to make a total postoperative period of from ten months to a year. The last cast is split, buckles are applied, and it is progressively removed over a period of a month while the patient is built up with back and abdominal muscle exercises.

Three cases, one polio, one idiopathic and one empyema will illustrate the treatment. In all the cases the last film was taken after all support had been removed and the patient returned to normal activity.

CASE OF IDIOPATHIC SCOLIOSIS

J. D., age thirteen, was perfectly well until the age of five when a slight curve was noticed. The patient was then placed on a frame for three months followed by braces until admission. There were no significant illnesses or family history. Physical examination showed a tall, well developed boy with a marked right dorsal scoliosis with considerable rib deformity. There was a one-inch list to the right, right shoulder one inch high, and right scapula very prominent. (Fig. 4.) The curve was somewhat stiff but still moderately correctible in suspension. In the sixteen months prior to admission the primary curve had increased from 55 to 108 degrees deviation from normal. (Fig. 6.) There was no muscle imbalance or paralysis; leg lengths were equal.

A plaster jacket was applied and correction to 45 degrees obtained in three weeks. Operative fusion took place from D4 to L2 in two stages, three weeks apart. The original plaster was removed in three months and the patient was allowed up in a jacket. Additional jackets were applied over a period of eleven months. The last jacket was split, buckles were applied, and then removed progressively over a period of one month. In the meantime the patient was doing back and abdominal exercises.

His preoperative height was sixty-three and one-fourth inches; after removal of support it was sixty-seven and three-fourths inches. Of this four and one-half inches, four inches of the increase was in the spine. The patient has good lateral motion and can touch the floor with the knees extended.

CASE OF EMPYEMA AND SCOLIOSIS

L. G., age fifteen, had pneumonia at the age of four, after which a left empyema developed and part of the sixth rib was resected in the axillary line. Drainage continued to the age of eight. At seven a scoliosis was noticed, as shown in Figure 8, which in seven years progressed from 19 to 74 degrees. At the ages of eleven and twelve plaster casts were applied for two months each. The patient was then put in a brace for the next three years. Examination showed a well developed girl who not only had a two and one-half inch list to the right, but had a rotation of the upper trunk to the left. (Fig. 9.) There was severe rib deformity with prominent scapula and ribs on the right, exaggerated flank crease and prominent hip on the left, and right dorsal scoliosis with primary curve D3 to D11 fairly well fixed but with some correction on suspension. There was no muscle weakness; leg lengths were equal.

Correction in plaster was secured to 19 degrees in three weeks. Spine fused from D1 to L1 in two stages four weeks apart. The patient was kept in the original plaster four months. She was allowed up with several changes of plaster to eleven months. The jacket was split and progressively removed over one month while the patient did exercises. At this time there was an excellent range of lateral motion and the patient could touch the floor with the knees extended. Preoperative standing height was fifty-nine and one-half inches, after removal of support sixty-three and one-half inches. There had been no leg growth. (Fig. 10.)

CASE OF POLIOMYELITIS AND SCOLIOSIS

D. L., age sixteen, had poliomyelitis at the age of nine with lower extremity and marked abdominal paralysis. Scoliosis was noticed at the age of twelve. At thirteen a right Lowman transplant was performed. The patient was markedly improved and could now sit and stand without support. There was rapid progress of the scoliosis. Examination showed a fat, poorly developed boy. There was right dorsolumbar scoliosis D6 to L2 of 94 degrees. (Fig. 11.) There was a one and one-half inch list to the right, high shoulder, exaggerated flank crease, prominent hip on the left, and a moderately severe right rib deformity. Leg lengths were equal. Right oblique and rectus abdominis were absent. Right quadriceps weakness and anterior tibial paralysis were present.

Correction in plaster to 28 degrees obtained in three weeks. Fusion from D4 to L3 in two stages took place four weeks apart. Original plaster was removed in four months and patient was allowed to get up. In eleven months the jacket was split and progressively removed over five weeks while the patient did exercises.

On forward bending hands come within one foot of the floor. Preoperative height was fifty-nine inches; at present sixty-six and one-half inches without any leg growth. (Fig. 12.)

SUMMARY

The author's experience with scoliosis has been discussed including 174 cases seen during a one-year period. The importance of determining the etiology has been stressed because it is the most important factor in prognosis and treatment. Both the conservative and operative management have been discussed and three cases are presented to illustrate the treatment.

Scoliosis is therefore considered a condition in which deformity can be prevented by proper treatment in the early stages, and can be definitely improved in the later stages. The physician should not be discouraged because the treatment is difficult and time consuming, for he will receive ample reward for his labors from the mental and physical improvement in his patients.

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GUIDE FOR INTERNAL FIXATION OF INTRACAPSULAR AND INTERTROCHANTERIC FRACTURES OF THE FEMUR*

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THE use of internal fixation for intracapsular and intertrochanteric fractures of the femur has increased the need for an efficient guide to facilitate accurate placement of screws, nails or wires. After considerable experimentation, the guide pictured in the accompanying illustrations was devised. Such a guide simplifies the technic of operation and decreases the operating time by reducing the number of *x*-ray films necessary to determine whether the screws, nails or wires are in their correct positions. Both of these factors are of vital interest to patient and surgeon.

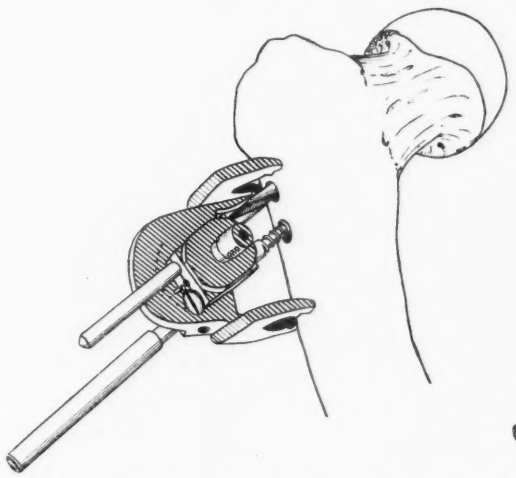

FIG. 1. Upper end of guide placed at junction of greater trochanter with shaft of femur (femur internally rotated 20 degrees). Handle of guide in horizontal plane. Drill holes made into neck of femur and replaced by double screws.

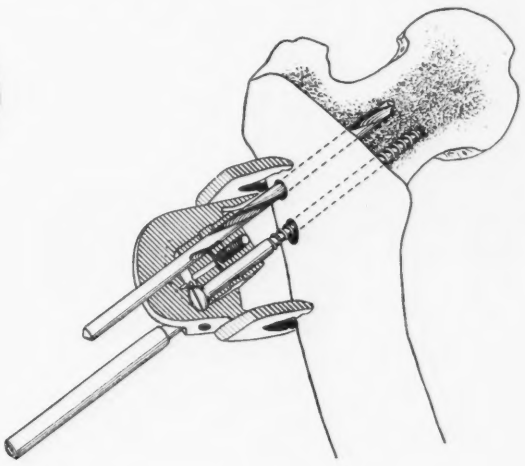

FIG. 2. Top piece of drill or wire director removed. Entire guide is then removed and both screws are driven into head of femur.

DESCRIPTION OF GUIDE

The guide consists of a metal frame with V-shaped ends, both notched at the bottom. (Fig. 1.) When the instrument is placed on the bone, one end is held against the greater trochanter at its junction with the shaft, and the other end fits on the shaft of the femur. The rough, notched edges of the V-shaped ends catch in the periosteum and prevent slipping of the instrument.

The guide is held against the femur by a handle (Fig. 1), which also serves the purpose of showing that the guide is in the horizontal plane. The handle is removable and can be screwed in at several points so that it will not be in the way of the operator.

A director, consisting of a square piece of metal placed midway between the two V's, guides the wire or drill into the neck of the femur. It turns on a pivot and can be set at any angle by a screw on the undersurface of the frame. (Fig. 3.) A needle on the director

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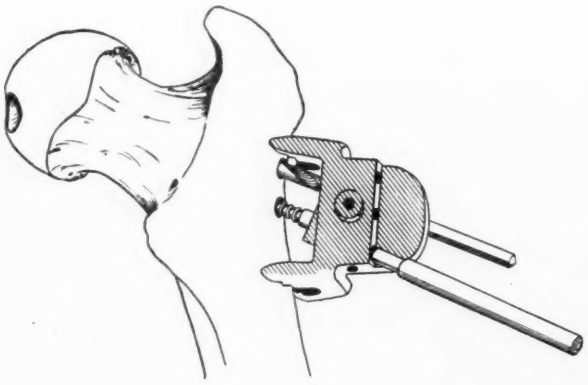

FIG. 3. Undersurface of guide. Set screw allows drill or wire director to be placed at any angle desired. By turning guide director, it may be used for either hip.

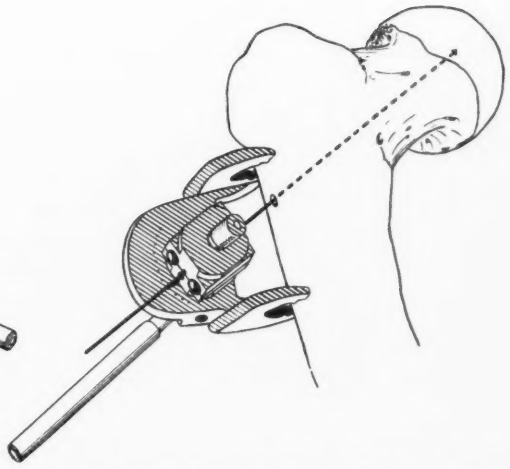

FIG. 4. Guide in place. Wire inserted into neck of femur. Smith-Petersen nail may be threaded over the wire.

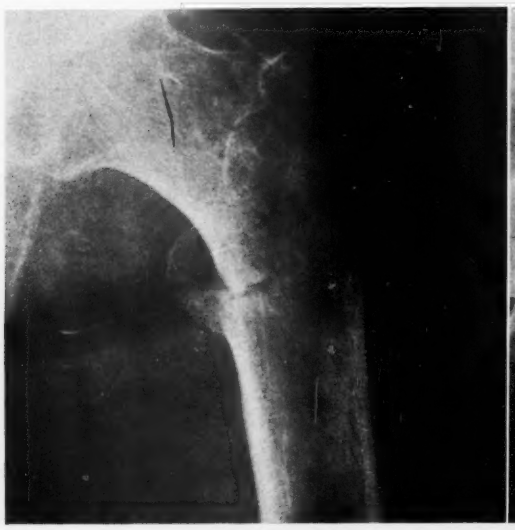

FIG. 5. Roentgenogram showing intertrochanteric fracture.

FIG. 6. Roentgenogram: anteroposterior view showing double screws into head of femur.

FIG. 7. Roentgenogram: lateral view, showing both screws into head of femur.

points to a scale on the frame to indicate any desired angle. The director is equipped with three openings, so that either double screws or a single wire can be inserted into the neck of the femur (Fig. 4), and is in two pieces horizontally so that the top half can be removed when screws are used, to allow the screws to be driven into the head.

Fig. 8. Roentgenogram showing wire into head of femur.

Fig. 9. Roentgenogram: anteroposterior view showing Smith-Petersen nail into head of femur.

(Fig. 2.) If a wire is used, the guide slips off by simply pulling it away from the femur.

The instrument can be used for either right or left femur by merely turning the director to the opposite side and reversing the ends of the guide.

METHOD OF USE

The fracture must first be properly reduced. The extremity is held in slight abduction and internal rotation of about twenty degrees. This amount of internal rotation places the femoral neck on a horizontal plane. With the extremity in this position, an incision is made approximately four to six inches in length over the lateral aspect of the greater trochanter, exposing it and about three inches of the shaft of the femur.

Fig. 10. Roentgenogram showing lateral view of Smith-Petersen nail into head of femur.

The guide is set at 127 degrees. It has been found by measurement of a large

number of femurs that the individual differences are not great, the shaft neck angle being approximately 127 degrees and about twenty degrees in the horizontal plane. On cross section, the neck of the shaft is approximately 1.8 to 2.5 cu. in. in diameter.

One end of the guide is placed just at the junction of the greater trochanter with the shaft, the other end on the shaft of the femur (Fig. 1), the handle of the guide being in a horizontal plane. A drill or wire is introduced into the neck of the femur. A roentgenogram is made to check the position of the drill or wire.

If double screws are used, the drill is removed and replaced with a three inch screw, and another drill hole is made parallel to the first. The drill is again removed and replaced with a three inch screw. Both screws are driven in as far as the guide will allow. The top half of the director is removed (Fig. 2), and both screws are driven into the head of the femur.

If a Smith-Petersen nail is used, a wire is inserted into the neck of the femur (Fig. 4), the guide is removed by simply pulling it away from the femur and the cannulated nail is then threaded over the wire and driven into the head of the femur.

The wound is then closed. The position of the drills is again checked by roentgenogram, this time from the lateral view. So accurate is the placing of the drills by the guide that the lateral view is taken after the operation.

Sufficient use of the guide has been made to warrant recording our experiences with it. It has been employed in thirty-eight instances and at no time has the head of the femur been missed in either plane. The use of the guide has eliminated the element of rough gaging of the position of the head and, in our experience, has reduced the operating time to thirty-five or forty minutes.

ANALYSIS OF FORTY-SIX CASES OF ACTINOMYCOSIS WITH SPECIAL REFERENCE TO ITS ETIOLOGY*

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THE Actinomyces bovis has been established by Wright[1] since 1905 as the causative organism of actinomycosis. However, there still remain many points unsolved in its pathogenesis. Biological research has continued to make new contributions[2] in an attempt to answer some of these debatable points. Yet, in the light of this newer knowledge there has been no comprehensive clinical study of any large group of cases of antinomycosis in this country for the past ten years.

In view of these facts it was considered an appropriate time to review the cases of actinomycosis occurring in the University Hospital in the past ten years. It will be the purpose of this paper to analyze these cases with special reference to: (1) their bearing on the mode of infection of the disease, (2) the results of treatment especially in the cervical cases and (3) to bring up to date our knowledge of the pathogenesis of actinomycosis.

Actinomycosis is an infection characterized by the usual presence of lesions composed of abundant granulation, or connective tissue surrounding multiple areas of abscess formation and by the presence within the abscesses of branching, Gramstaining, filamentous, anaerobic organisms with radially-disposed, club-bearing filaments.† The disease has been fully described by many observers. Ruhrah[3] collected fifty-eight American cases in 1899. This number was brought up to a hundred by Erving[3a] in 1902. In 1922 Sanford[4] was able to collect almost 700 unreported cases in this country.

† Definition given the author by F. T. Lord.

In a ten year period, 1926 to 1936, there were forty-six cases of actinomycosis in the University Hospital. Thirty-two of these cases were confirmed either by finding sulfur granules in exudate from the lesions and the demonstration microscopically of the ray fungus, or by similar findings of the club-bearing filaments in biopsy specimens or at autopsy. A follow-up study was made and twenty-two patients were heard from.

GEOGRAPHIC DISTRIBUTION

In Michigan, as shown by Sanford's[4] complete survey, there is not the greatest incidence of the disease, but it is located in that portion of the Northwest where there are a greater number of cases seen than in any other part of the country, except the states of New York and Massachusetts. However, it is probable that this greater prevalence of the disease in any one locality is only apparent and may be due to greater interest in and familiarity with the disease in that particular locality.*

McKenty[5] noted that all but several of his thirty-seven cases came from within a radius of one hundred miles of Montreal. Earlier writers have suggested this endemic nature in reports of actinomycosis in cattle where certain herds of cattle fed in particular salt marshes. This endemic character of the disease has also been noted where the infected animals were known to be feeding on a certain batch of grain (Jensen); but Johne[5] in 1888 fed cattle on food infected with cultures of the organism and none became infected.

* F. T. Lord: Personal communication to the author.

* Studies and contributions from the Department of Dermatology and Syphilology, Service of Dr. U. J. Wile, University of Michigan Medical School.

Our group of cases was fairly well distributed over the state with a few cases from nearby states. There was no evidence of endemicity.

An interesting point was the fairly even distribution between rural and urban population, a point which has not been mentioned in other reports.

AGE AND SEX

Most writers agree in describing actinomycosis as occurring in middle age. A comparison of age distribution is made in Table I with that reported in other groups. Eighteen, or thirty-nine per cent occurred in persons past midlife which seems to be an unusually high percentage of occurrence in people in the higher age bracket.

TABLE I
COMPARISON OF AGE DISTRIBUTION WITH THAT GIVEN IN OTHER REPORTS

Name	No. Cases	Age, Per Cent			
		20–50	25–35	25–45	Past 40
Sanford and Magath*	119 / 96	..	..	60	
New and Figi	107	70			
McKenty	37	..	60		
Erving	100	64			
University Hospital	46	..	..	..	39

* One hundred nineteen collected cases and ninety-six Mayo Clinic cases.

As in other reports there was a marked preponderance of males over females, a well accepted characteristic of the disease.

ANATOMIC DISTRIBUTION

It is generally conceded that the majority of actinomycotic infections occur in the cervicofacial region. This is well demonstrated in the accompanying comparative Table II, showing the sites of election for the disease as found by other observers. In our group there were equally as many cervicofacial cases as there were thoracic and abdominal cases together.

Among the cervicofacial cases were two primary infections of the tongue, previously reported from this department.[6] In two instances actinomycotic-like organisms were found on pathologic examination of tissue, occurring as a secondary invader at the edges of a wound.

TABLE II
COMPARISON OF UNIVERSITY HOSPITAL CASES WITH THAT OF OTHER REPORTS IN RESPECT TO ANATOMIC DISTRIBUTION

Name	No. Cases	Head and Neck	Thorax	Abdomen	Skin
Sanford and Magath*	119 / 96	62 / 64	16 / 4	9 / 3	
Coller	50	20	5	17	
New and Figi	107	68.1%	7%	20.3%	
McKenty	37	19	2	16	
Erving	100	53	20	23	
University Hospital	46	23	9	14	

* One hundred nineteen collected cases and ninety-six Mayo Clinic cases.

MODE OF INFECTION

For thirty years two widely different views have been prevalent concerning the mode of infection obtaining in actinomycosis. On the one side, there are those who believe that the organism gains entrance to the body through grasses, grains, etc., upon which the organism lives in the outside world and by means of which the infection is carried to the tissue. Contact with "lumpy jaw" in animals is also considered a source of infection. More recently vegetables packed in straw have been suggested as another possibility.[7,8] This theory is upheld by the followers of Boestrom, who in 1890 isolated a streptothrix, which was apparently identical with an aerobic organism found widespread in nature, upon grasses and grains. This theory is further supported by the fact that many cases are reported in which barbs of barley or grain have been found in the lesions of men and animals, and many instances in which there is a history of swallowing a blade of grass

The followers of this theory also take the reports of instances of endemic actinomycosis among cattle fed on certain fields of grain as further evidence in support of their theory.

There is an opposing theory, based on the well known and accepted work of Israel and Wolff,[9] later Wright,[1] and others, demonstrating that the organism causing true actinomycotic lesions never grows on grasses and grains and has quite different cultural characteristics from that of Bostroem.[14] Actinomyces bovis is a facultative anaerobe, difficult to grow, grown only at body temperature. These facts have given rise to the view upheld by Wolff and Israel,[9] and Homer Wright,[1] as well as by Lord,[10] and Naeslund,[11] that the Actinomyces bovis does not have its usual habitat in the outside world on grain and grasses, but normally inhabits the digestive tract, particularly the mouth, where it remains as a saphrophyte. Given the proper conditions of a lower resistance and portal of entry, the organism becomes pathogenic with the production of a lesion.

OCCUPATION

It is commonly stated that the disease is more common in those handling hay or those who come in contact with animals afflicted with "lumpy jaw." However, in reviewing the reports with this particular point in mind, it would seem that the actual facts do not substantiate this generally accepted impression.

Sanford and Magath[12] reported on 119 collected cases, and ninety-six cases from the Mayo Clinic; of their 119 collected cases only sixteen were farmers (one-quarter not noted). In Sanford's[4] 678 collected cases, 50 per cent only were in contact with cattle or in occupation which predisposed them to infection. Furthermore, there was no definite relationship noted between the distribution of the disease in the entire country and the distribution of the prevalence of diseased cattle. In Mckenty's[5] thirty-seven cases, nineteen were farmers, one a grain merchant and two gave history of contact with infected animals. Mattson[7] is of the opinion that infection is acquired from animals in a goodly number of instances. In twenty-six answers to questionnaires he found fifteen patients gave a history of treating animals with "lumpy jaw." New and Figi[13] likewise through eighty answers to a questionnaire reported that while thirty-five or 43.7 per cent had been associated with the disease in animals, forty-five or 56.1 per cent had not come in contact with diseased cattle. However, the time elapsing from the time of exposure, to the recognition of onset of symptoms, averaged five and one-half years, varying from six months to twenty-five years. They concluded that the probability of direct infection from cattle was questionable. Rather, they felt that the presence of "lumpy jaw" in cattle in the neighborhood from which patients with the infection came, probably indicated that the organisms were abundant on the vegetation of the locality, rather than that the diseased animals were the primary cause of the infection in man.

Contagion from man to man has never been definitely established.[14] Ochsner's[14] two well known cases are usually cited as examples of this occurrence. In one instance the man drove a horse with "lumpy jaw," in the other the patient had handled infected cattle. There is one case reported in which infection is presumed to be transferred from man to man. This is McKenty's[5] case of a nurse who was infected by administering to a patient with actinomycosis. But McKenty himself states that the proof was not convincing.

Though Mattson[7] leans toward the frequency of the transmission of the disease from animal to man, he cites Salmon's experiment of placing twenty-two infected cattle with healthy cattle for four months, without any of the well cattle becoming infected, which is certainly convincing evidence against infection by contact. As Cahill[15] has stated, the disease is not contagious, being exceedingly difficult to

produce the disease by injecting infected pus into animals.

Only fifteen of our forty-six cases were farmers, or less than 35 per cent. The remainder were divided among laborers, professional men, mechanics and clerks. Eleven were classified as unemployed.

A questionnaire was sent to twenty-six of our patients in which they were asked the question. Had they at any time come in contact with animals who had "lumpy jaw" or similar infections? To this question sixteen answers were received, all in the negative.

HABIT OF CHEWING GRASS

That actinomycosis is contracted through the introduction into the oral cavity of straw, grain and grasses which are infected, has been handed down to medical students through classroom and textbooks for the past fifty years.

There are numerous instances in the literature in which infection is said to have followed the chewing of grass, or the swallowing of a blade of grass, or again where infection has occurred through injury of the oral mucous membrane by a barb of barley or beard of grain. Such is Cope's[8] case of a child of ten, who developed an actinomycosis of the jaw after swallowing a blade of grass which stuck in the tonsil. Soltman[7] had a similar case in which a youngster developed actinomycotic abscesses in the chest after swallowing a barley awn, which was later found in the pus from the abscess. New and Figi[13] reported the history of a foreign body in five of their cervical cases, and there have been similar reports by others. In all these reports, however, it must be noted that such instances only make up a very small percentage of any one group of cases.

Colebrook[16] and Lord[2] have both expressed skepticism, regarding any view which considers the infection as being introduced through such a mechanism as these cases would indicate, as the organism, which is commonly found on vegetable sources, is an aerobic fungus, not conforming bacteriologically to the type of organism used to describe this group. The anaerobic organism of the type of Actinomyces bovis has never been demonstrated unquestionably in natural sources outside the human body; they postulate, therefore, that anyone who adheres to the idea that the organism of actinomycosis is introduced into the body by vegetable matter, must presuppose his own hypothesis as to how this organism existed before entering the human body. There is no biological evidence to substantiate any of these hypotheses, such as existence of a spore formation in the life cycle of the organism.

Mattson[7] is the only one who gives definite figures on patients concerning their habit of chewing grass or grain. He states that of twenty-six patients asked this question in a circular letter, eleven answered in the affirmative.

Of our forty-six cases there were only three who gave a history of chewing grass or straw. Circular letters were likewise sent to twenty-six patients, and in answer to the question, "Have you ever been in the habit of chewing on straw or grass?" there were none who admitted this habit.

Epstein[17] has recently stated that the theory that the disease is contracted by chewing straws, grasses, etc., is not well founded, and from a clinical standpoint the hypothesis in many cases does not fit the clinical history. Our findings bear substantiation of this clinical impression which has also been voiced by others.[2,10,12] Thus it may be that a very old idea handed down through the textbooks might need revision.

DENTAL ORIGIN

Homer Wright[1] showed that the true actinomycosis described by Israel and Wolff,[9] in 1878, is not found outside of the animal body, and the etiological relationship of the organism of the Wolff-Israel type to actinomycosis is now regarded as established. For this reason Wolff and Israel, as well as Homer Wright,[1] Lord,[10] and Naeslund,[11] have at various times expressed the belief that the Actinomyces

bovis is a natural inhabitant of the gastro-intestinal tract, especially of the mouth.

Origin of the disease from organisms normally harbored in the buccal cavity is further suggested by finding in carious teeth and tonsillar cysts of normal people, smears, and sereal sections showing organisms with the morphology and staining reaction of actinomyces.

In examination of 10,000 tonsils Wilkson[18] found bodies which resembled those found in cases of actinomycosis in 177 cases. Actinomycosis occurred second in order of frequency among the pathologic conditions found in the tonsils examined. These were believed to be of the non-pathogenic variety, however. Weller[19] in examination of 1,000 tonsils found forty-seven out of eighty positive cases of tonsillar concretions of the crypts to be actinomyces-like colonies of mixed mouth organisms.

Lord[1,20] noted in the sputum from patients without clinical evidence of actinomycotic infection, the occasional presence of organisms with the morphology and staining reaction of actinomyces. He likewise observed that patients with actinomycosis often gave a history of previous trouble with their teeth. Knowing the failure of actinomycosis to grow at other than body temperature and the lack of evidence of its contagiousness, the fact suggested itself to him that the disease arises from within rather than from without the individual.

Thus in 1910 Lord[20] inoculated guinea pigs intraperitoneally with the contents of carious teeth of patients without actinomycosis and produced omental tumors in 60 per cent, histologically identical with actinomycotic tissue, and containing typical club-bearing actinomyces granules. Lord[20] later noted that similar lesions were produced in animals inoculated with the scrappings from sound teeth. An attempt to isolate the organism in pure culture, however, failed. These findings furnished evidence in favor of the buccal cavity as a normal habitat of Actinomyces bovis. To prove the identity, however, of the organisms found in the mouth with Actinomyces bovis, it would be necessary that pure cultures be obtained, as certain strains of streptothrix are capable of forming similar appearing colonies when inoculated into animals. It was this point in the failure of the experimental work, to which Mattson[7] pointed in 1922 as showing the unliklihood of true actinomycosis being present in the mouths of normal persons. However, in 1925 Naeslund[11] confirmed Lord's findings, and produced experimentally in animals, lesions histologically identical with actinomycotic tissue and containing club-bearing actinomyces granules, by the inoculation of animals with material obtained from the normal mouth. He was further successful in isolating from the normal mouth anaerobic organisms morphologically and culturally like the actinomyces of the Wolff-Israel type. He was later able to produce with these cultures lesions in animals characteristic of actinomycosis. This establishes the fact that antinomyces of the Wolff-Israel type is present in normal mouths and is a long step forward toward substantiating Wright's theory that the organism is a normal inhabitant of the oral cavity.

That the disease may arise from organisms normally found in the oral cavity, has been suggested by a number of writers and investigative workers. Many observers have noted and commented upon the greater frequency, with which the disease occurs in the head and neck than in any other portion of the body. Likewise there has been noted the unusually large number of cases in which carious teeth are found present in the mouth, or in which there was a previous history of some difficulty with the teeth. Sanford and Magath[12] in ninety-six cases reported from Mayo's, noted in almost all cases, a history of preceding tooth or tonsil trouble. They concluded that the alimentary tract played a very important part in the source of infection. Ruhrah[3] noted that carious teeth, in which the lower jaw is involved, seemed to play an important rôle. In McKenty's[5] thirty-seven

cases, of those in which a history was given, there were eight following extractions or infected teeth. New and Figi[13] concluded that the organism of actinomycosis is probably a common inhabitant of the normal mouth. Coller[21] likewise noted the finding of carious teeth, and that the infection was not uncommon following tooth extractions. Warwick[22] describes the case of a woman who a few months following aspiration of a tooth developed a thoracic actinomycosis. There are also two cases, one of Cope[8] in England, and one of McWilliams[7] in this country, in which actinomycosis of the finger developed in each instance, following a human bite by a person without actinomycosis.

In seven of our cases, infection was preceded by only a few days to a few weeks by the extraction of teeth. In one case there was a history of an abscessed tooth, and in another instance actinomycosis was found in the pathological examination of the tonsils without evidence of infection elsewhere in the body.

It is usual to consider that some break in the tissue precedes the infection and acts as a portal of entry. There was, however, an unusually large number of cases in which it was impossible to point to a break in the skin, or mucous membrane preceding infection. Eighteen cases, or 39 per cent of the group may be included in such a classification.

In four abdominal and thoracic cases, and three cervical cases, there was a history of onset of infection following a severe blow to the body but without causing an actual break in the continuity of the tissues. Six abdominal and thoracic cases were preceded by appendectomy, a well known occurrence. It would seem that either a microscopic break in the tissue is necessary or that the tooth in many instances acts as an area of lowered resistance.

RESULTS OF TREATMENT IN THE CERVICAL CASES

It is the general experience of most observers that the prognosis in the cervical cases is far more favorable than in the abdominal and thoracic infections.

McKenty[5] treated nineteen cervical cases; of these four were not traced, two showed no improvement and one was chronic over an eight-year period, dying of a chronic nephritis with freedom of nine months from actinomycosis. Of twenty-one cervical cases treated by Mattson[7] twelve were entirely cured, seven were improving when heard from. His mortality in appendiceal and pulmonary cases was 100 per cent in six months to a year. New and Figi[13] traced eighty-five of their patients of whom thirty-six were well for one to five years. Seven had died, and in twenty-four the condition was not stated.

For numerous reasons, the interval between the time the patient was aware of symptoms and the time that he presented himself for treatment was in most instances quite long. Only one patient was seen in which the infection had been present less than a month. Eight were not examined until the lesion had been present six months or longer. The interval varied in the remaining seven patients from one to six months.

A ten year follow-up study was made on twenty-two of our cases. This consisted of thorough re-examination in the clinic and when this was impossible by follow-up letters. The results are striking. Of the total twenty-three abdominal and thoracic cases originally seen, all but one had died at the end of fourteen months, and the one still living had active lesions in the chest at the end of one and one-half years. Of those sufficiently well to leave the hospital, seven months was the average length of time before death.

Results in the cervical cases present a brighter picture. Of the total twenty-three cervical cases treated at the University Hospital during the past ten years fifteen were followed. Of these all but one was cured on an average of two and one-half months after discharge from the hospital. The length of time required for healing varied from ten days, following discharge

from the hospital, to six months. One patient died of a condition unrelated to his infection, which was healed at the time of death. One patient had a lesion present on the cheek for ten years and finally died with generalized metastases.

For these reasons the biologist believes the organism of actinomycosis to be a natural inhabitant of the digestive tract, especially the mouth, and believes that the infection is introduced into the body from outside sources. There is no biological evidence to support the hypothesis that actinomycosis is introduced into the body by vegetable matter.

TABLE III

RESULTS OF TREATMENT OF 46 PATIENTS WITH ACTINOMYCOSIS WITH TEN YEAR FOLLOW-UP STUDY ON 22 CASES. DATA ON RESULTS OF TREATMENT IN OTHER LARGE GROUPS OF CASES IS GIVEN

Name	Total	Type	Cured	Improved	Chronic	Died	Not Followed
McKenty	19	Cervical	12	2	..	..	4
Mattson	21	Cervical	12	7	..	..	2
Figi	85	All types	36	..	..	7	24
University Hospital	46	Cervical	14	..	..	1*	8
		Abdominal thoracic	..	..	1	22	

* Actinomycosis of cheek present for ten years. Died of generalized spread. There were two cases of several years' cure, in which there was death from entirely unrelated causes. These cases were considered as cured.

Treatment in the University Hospital both on the dermatological and surgical services consists of Lugol's wet dressings, iodides to tolerance, plus *x*-ray and surgical drainage when indicated.

In reviewing the results of these cases the malignant nature, the frequency of metastases and the high mortality in abdominal and thoracic cases as compared with cervical infection showed the same disproportion as given in other reports.

SUMMARY

The theory that actinomycosis is contracted by chewing straws, grasses, etc., is at variance with the present day biological and bacterological concept of the mode of infection of this disease. An attempt has been made to correlate clinical findings with the facts now well established by the laboratory.

It is now a definitely established and accepted fact that the true causal organism of actinomycosis is an anaerobe, never found growing in the outside world. Furthermore, it has been cultured from the mouths of normal individuals with the subsequent production of typical actinomycotic infection in the tissues of laboratory animals.

Findings in our own cases and in that of collected material would tend to show that the habit of eating grass, the proximity to infected animals, and special types of occupation, things which we have heretofore associated with the mode of infection of actinomycosis, are probably present considerably less than 50 per cent of the time.

Although sufficient material has not been presented upon which to make any definite conclusions, clinical findings have been given which would at least question whether there is need for a revision of our ideas of the mode of infection of actinomycosis.

Actinomycosis is still a relatively rare infection, there being only forty-six cases seen in a period of ten years, or less than five cases per year, and this in a portion of the country in which actinomycosis is purported to be relatively prevalent.

The fairly even distribution of actinomycosis between the rural and urban population is noted for the first time.

A relatively good prognosis is indicated in the cervicofacial cases as evidenced from the results obtained in treatment of such

cases whereas the outlook in thoracic and abdominal cases is extremely grave.

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CLINICAL OBSERVATIONS ON SOME SYSTEMIC EFFECTS OF PITRESSIN*

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PITRESSIN,† the pressor principle of the posterior lobe of the pituitary body, is a hormone known to cause contraction of smooth muscle.[1] Because of this action it has been recommended and employed for the prevention and treatment of postoperative abdominal distention, urinary bladder atony and arterial hypotension.

Unlike cholinergic drugs which cause smooth muscle contraction through the intermediary of acetylcholine at the neuro-effector cell, the pressor effect of pitressin is exerted directly upon smooth muscle. The end result on most of the autonomic tissues, is not unlike parasympathetic stimulation.

This report is an analysis of clinical observations concerning the effects of pitressin on the principal autonomic systems: (1) the gastrointestinal tract, (2) the cardiovascular system, and (3) the respiratory system. Therapeutic doses of the drug were administered hypodermically to patients prior to, during and following abdominal surgical interventions.

1. EFFECTS ON THE GASTROINTESTINAL TRACT

Intestinal contraction can be observed directly in the opened abdomen five to ten minutes following the intramuscular injection of a therapeutic dose of pitressin. It is this effect which has prompted the use of this drug in the prophylaxis and treatment of postoperative abdominal distension.[2]

Coincident with intestinal contraction is peritoneal relaxation. This effect may be very striking and seems analogous to the relaxing effect reported by Garrelon[3] following the administration of physostigmine in cases of resistant abdominal rigidity during celiotomy.

2. CARDIOVASCULAR EFFECTS

Most of the untoward effects observed following pitressin therapy have been circulatory reactions of the depressive type usually characterized by pallor and fall in blood pressure with its implicative symptoms.

Laboratory studies on the cardiovascular effects of pitressin have been numerous. Gruber and Kountz[4] have shown that it affects the dog's heart in several ways: first, it acts through the vagi by stimulation of the cardio-inhibitory center; second, it causes constriction of the coronary arteries with resultant asphyxia of the myocardium. In addition there are changes in the conductive system resulting in partial heart block, shifting of the pacemaker and sino-auricular block. Mellville[5] confirmed the coronary constricting action of pitressin and suggested that it is the cause of the other cardiovascular effects. Ross, Dreyer and Stehle[6] have likewise found that coronary spasm is at least one of the important factors which may cause a fall in blood pressure. More recently, Katz and Lindner[7] concluded from their studies that "the occurrence of powerful constriction in the coronary vessels following pitressin suggests the possibility that coronary spasm can and may occur in man."

The following case report illustrates a circulatory effect following the administration of pitressin:

† Manufactured by Parke, Davis and Company.

* From the Department of Anesthesia, Division of Surgery, New York University College of Medicine, and the Hospital for the Ruptured and Crippled, New York City.

Case I. Laparotomy was proposed for the removal of a Miller-Abbott tube impacted in the transverse colon. The patient, a woman of fifty-seven, was greatly debilitated from the unsuccessful attempt to pass the tube for relief of postoperative intestinal paralysis. The preoperative arterial pressure was 90/50 mm. Hg and the pulse rate was 120. Anesthesia was induced using cyclopropane with a closed endotracheal technic. During celiotomy the end of the Miller-Abbott tube was found impacted in the transverse colon and the proximal part of the gastrointestinal tract was ruffled about the tube with numerous perforations of the stomach and intestine. Ten minutes after surgery was begun the arterial pressure had fallen to 70/50 mm. Hg. An infusion of 1,000 cc. of a 5 per cent solution of glucose in saline was started with resulting temporary improvement. After an hour and a half, however, the arterial pressure fell progressively to 60/45. A 500 cc. blood transfusion was started and pitressin ½ cc. (10 units) was slowly injected intravenously to counteract the low blood pressure and to stimulate intestinal contractions. Within five minutes marked pallor developed while the arterial pressure showed a significant rise to 120/60. Then, in spite of the presence of a patent endotracheal airway with excess oxygen available, the patient began to use her accessory muscles of respiration. The arterial pressure fell to 60/50 mm. Hg in a half hour at which time the operation was completed. Excess oxygen was administered in view of the respiratory distress but seemed ineffective. The pulse became rapid and thready and the patient expired 20 minutes after the operation was completed.

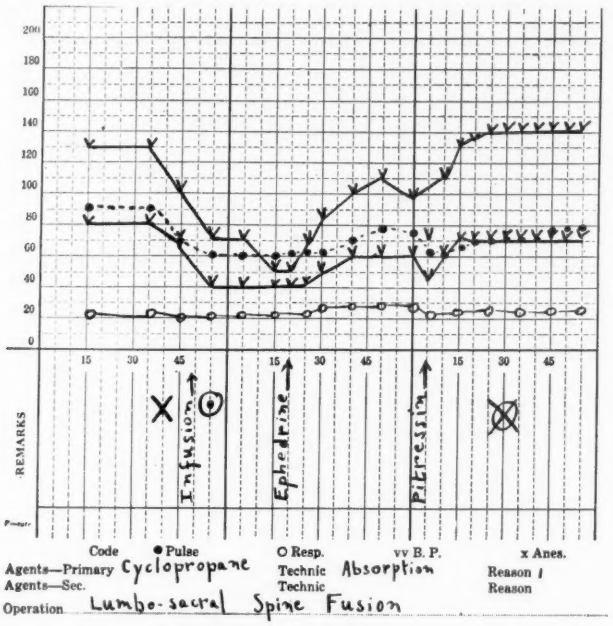

Fig. 1. Effect of pitressin on arterial pressure following the preliminary administration of ephedrine.

The pathology presented by the patient revealed a fatal prognosis but this case indicates the inadvisability of intravenous pitressin administration even in minute doses.

There is evidence to indicate that the depressive circulatory effects of pitressin secondary to coronary constriction may be prevented by the preliminary administration of ephedrine.[7] Clinical observations seem to substantiate this effect as the following case report illustrates:

Case II. (Fig. 1.) F. L., a woman of thirty-five, had a pseudarthrosis of the lumbosacral spine for which a spine fusion was proposed. Physical examination revealed no other defects than a marked dermographia and considerable apprehension. On the day of operation, morphine sulfate 0.010 Gm. (gr. ⅙) and scopolamine 0.00048 Gm. (gr. 1/150) was administered subcutaneously at 7:45 A.M. The patient became unusually pale and during the next hour was nauseated and vomited several times. The

arterial pressure, taken at 8:35 A.M., just prior to the administration of anesthesia, was 130/80 mm. Hg and the pulse rate was 92 beats per minute. Cyclopropane anesthesia was begun at 8:40. A routine infusion of 5 per cent glucose in saline was given at 8:50. At 8:54 when the operation was started the pulse rate had decreased to 60 beats per minute and the arterial pressure showed a surprising fall to 70/40 mm. Hg. Ten minutes later the pulse rate was 58 and the arterial pressure 52/40. The patient's color was natural, respiratory movements were of normal rate and amplitude and the skin was warm and dry. However, because of the circulatory depression, ephedrine sulfate, 50 mg., was administered subcutaneously. During the next thirty minutes the arterial pressure rose gradually to 110/60 mm. Hg and the pulse rate increased to 78. But after fifteen minutes the arterial pressure had fallen again to 70/40 and the pulse rate had decreased to 58. One cc. of pitressin (20 units) was then injected intramuscularly. The arterial pressure rose to 140/70 within ten minutes and it remained at this level until the termination of the operation. Postoperatively, the arterial pressure stayed remarkably constant between 130/70 and 138/70 mm. Hg for several days.

This case indicates the beneficial effects of the pressor action of pitressin, preceded by ephedrine, in a patient with apparent autonomic nervous system imbalance, characterized by seemingly sympathetic depression caused by general anesthesia. The sympathetic hyperactivity manifested by this patient in the wakeful preoperative state consisted of marked apprehension, tachycardia, pallor and dermographia. When consciousness was lost under anesthesia, the autonomic imbalance was further disturbed as evidenced by bradycardia and marked hypotension. A therapeutic dose of ephedrine resulted in only temporary improvement. The administration of pitressin then showed more rapid and better amelioration which was maintained.

In cases of active celiac plexus reflex during abdominal surgery,[8] characterized by marked diminution of pulse pressure during mechanical stimulation of the celiac plexus, administration of pitressin has been followed by a return of the arterial and pulse pressures to normal limits as exemplified in the following case report:

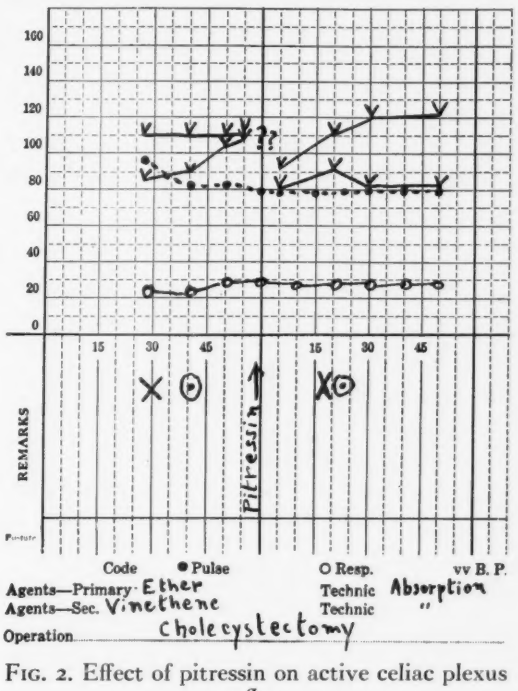

Fig. 2. Effect of pitressin on active celiac plexus reflex.

Case III. (Fig. 2.) M. H., female aged 32 years, cholecystectomy indicated for cholecystolithiasis. She was a poor cardiac risk because of rheumatic heart with valvular lesion, functional capacity IIB, and auricular fibrillation. Anesthesia was induced with vinethene-ether sequence using the closed carbon dioxide absorption technic with excess oxygen. The arterial pressure at the onset was 110/85 mm. Hg; the pulse rate 96 beats per minute and irregular. Induction of anesthesia was uneventful and surgical intervention was begun in eight minutes. Ten minutes later, during abdominal exploration, the arterial pressure changed to 110/106, showing a rise in diastolic pressure while the pulse rate was 80 per minute and more regular than normally. Five minutes later the arterial pressure registered 110/108 (pulse pressure of two). Intervention progressed rapidly and was characterized by a minimum of bleeding. Five minutes later the facial pulse rate was still 80 per minute and the respiratory rate 24 with good volume exchange, but upon attempting to determine the arterial pressure no reading could be obtained during the next ten minutes. Pitressin, 20 units, was injected

intramuscularly. Six minutes later the arterial pressure could again be discerned at 90/80 and the improvement continued steadily during the next twenty-five minutes at which time the pressure had returned to 120/80 when the operation was completed.

The patient reacted twenty minutes after anesthesia was discontinued and recovery was uneventful.

3. EFFECTS OF PITRESSIN ON THE RESPIRATORY SYSTEM

Laryngospasm, bronchoconstriction and increased mucous secretion have occurred when pitressin was administered during anesthesia especially in asthmatic individuals. In several cases, asthmatic rales which had increased during cyclopropane anesthesia,[9] were relieved either by changing to ether or by injecting atropine, and recurred five to ten minutes following the intramuscular injection of pitressin. Likewise, pitressin administered postoperatively in asthmatic individuals was frequently succeeded by symptoms simulating an asthmatic attack.

Case IV. R. W., a male, aged fifty-eight years, presented a recurrent inguinal herniorrhaphy. He was the typical barrel-chested, emphysamatous type giving a history of frequent attacks of asthma. Preoperatively some bronchial wheezes were audible. Anesthesia was induced with cyclopropane and surgery begun nine minutes later. It was then observed that the asthmatic rales and wheezes had greatly increased. Respiration became shallow and effortful on expiration and subcyanosis developed despite the high oxygen concentration in the breathing bag and despite a clear upper airway. This state persisted during fifteen minutes until ether was added to the anesthetic mixture whereupon the minute volume respiration increased, subcyanosis disappeared and pulmonary auscultation revealed clearing of the bronchial passages. This amelioration was maintained during the next forty minutes. Because the hernia involved a great intestinal mass it was deemed advisable to prevent postoperative intestinal atony by the administration of pitressin. Accordingly, 1 cc. of the drug was injected intramuscularly. Six minutes after the injection the bronchial wheezes recurred, perspiration and lacrymation appeared, and respiration again changed in character, becoming difficult and prolonged on expiration. Operation ended a few minutes later and pitressin was ordered to be administered every four hours. Upon return to bed the patient's pulse rate was 86 beats per minute, the arterial pressure 130/70 mm. Hg, the respiratory rate 24 per minute but with prolonged expirations. Pitressin was again injected. Dyspnea then increased, perspiration became excessive and cyanosis became evident. Oxygen therapy by nasal oropharyngeal insufflation was started. Pitressin was administered regularly every four hours. Following each injection the pulse rate increased steadily until it reached 130 the following morning while the temperature rose to 101°F., and dyspnea continued. It was then suggested to cease pitressin therapy, and atropine 0.0006 Gm. (gr. $\frac{1}{100}$) was injected intramuscularly. Dyspnea decreased within a half hour and the pulse rate fell to normal limits within four hours. The next day pulse and temperature were normal. The patient looked good and recovery for the next two weeks was uneventful.

SUMMARY AND CONCLUSIONS

Observations of patients receiving pitressin therapy have revealed the frequency of varied systemic effects. Besides the beneficial effects for which the drug is indicated, certain detrimental reactions may also occur.

The beneficial effects observed have been: (1) intestinal contraction; (2) peritoneal relaxation during abdominal surgery; (3) rise in arterial pressure; which effect is prolonged by preliminary ephedrine administration; and (4) alleviation of celiac plexus reflex during abdominal surgery.

The detrimental reactions which may occur are: (1) fall in arterial pressure following a preliminary temporary rise; (2) cardiac irregularities; (3) coronary constriction; (4) increased mucous secretion and laryngospasm during anesthesia; and (5) bronchospasm, especially in asthmatic individuals.

Because of these varied effects it is suggested that the administration and dosage

of pitressin therapy be guided by individual reactions and susceptibility. The use of ephedrine to counteract circulatory depression following pitressin therapy is advised.

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Caseation is almost always a property of tubercle formation, but it is not regular in its quantitative phase or time or appearance. The size of tubercle, the type of parasite, and the nutrition of the host seem to influence its development considerably.
From—"Age Morphology of Primary Tubercles"—by Henry C. Sweany (Charles C. Thomas).

MULTIPLE FRACTURES OF THE SKULL COMPLICATED BY FRACTURES OF THE JAWS*

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MULTIPLE fractures of the skull complicated by fractures of the upper and lower jaws are of comparatively infrequent occurrence. Even large clinics report relatively few cases. When one searches the literature to obtain aid in the handling of these complicated cases, one is struck by the paucity of the reports and more so by the vagueness as to their management. For this reason the author believes that a detailed description of this case and its treatment will be a valuable contribution on this subject.

There were approximately 4,100 patients with fractures of the skull admitted to the Boston City Hospital in the twenty-five year period from 1915 to 1939 inclusive; 727 of these were female. The ages ranged from newborn infants to ninety-two years. All types of fractures were encountered, from the simple fracture without any intracranial involvement to the multiple compound type with severe brain complications. The sites of the fractures were either the vault or the base. Some were complicated by involvement of the nasal sinuses, mastoid, middle ear and jaws. There were 1,489 deaths resulting in a mortality rate of 36 per cent. If deaths occurring the first forty-eight hours are excluded, the mortality rate would probably be nearer 25 per cent. It must also be borne in mind that these were not selected cases but were admissions of severely injured patients, many in a dying or comatose condition. Further, they were treated on the general services of the hospital in contradistinction to those patients referred to the Neurological Service, the statistics of which appear elsewhere in this paper.

There were thirty-four cases complicated by fracture of the jaws, an incidence of 0.8 per cent. Twenty-eight of these were simple fractures, three were compound fractures and in three no mention was made in the record. In this series there were eight deaths, seven occurring within the first forty-eight hours of admission.

It is estimated[1] that in the United States 112,000 skulls are fractured annually with 28,000 deaths, a mortality of 25 per cent. The greatest mortality occurred within the first twenty-four hours.

The general mortality rate for Ramsdell's[1] series of one hundred consecutive cases was 23.0 per cent. Mock,[2] in a statistical study of 8,649 cases, showed a general mortality rate of 20.0 per cent.

The following table is a statistical analysis of cases of fracture of the skull with cranial injuries referred to the Neurological Department from the General Services of the hospital.

TABLE I
NONOPERABLE CASES

Ratio of Occurrence	Living	Dead	Total	Mortality Per Cent	
63.0 nonoperable cases	652	106	758	13.9	
0.9 concussion	11	0	11	0.	
18.2 edema and congestion	226	3	229	1.3	
25.7 contusion	292	17	309	5.5	
43.0	...	...	....		19.8
17.3 laceration	123	86	209	41.1	
Total series	953	250	1203	20.7	

From the table above, it may be seen that the nonoperable cases comprise 63.0 per cent. Under the methods of treatment as carried out at the Boston City Hospital, the immediate mortality has remained about 14.0 per cent.

This is figured from all such cases without regard to the time of their death after

* From the Aural Service of the Boston City Hospital, Boston, Massachusetts.

admission to the hospital. Since these figures are from admissions to specialized service (Neurological Service of the Boston City Hospital), from a general hospital they tend to be higher rather than lower as cited above.

It is impossible to standardize the treatment of all craniocerebral injuries, as each individual case presents its own requirements. The character of the pathology must, in the last analysis serve as a guide for the kind of treatment. The following is an outline of the nonoperative care which I employ in the great majority of cases. This is not to imply that operative indications in this group should be ignored.

TREATMENT

A summary of the non-operative treatment in craniocerebral injuries and as carried out in this case follows: (1) Rest in bed; (2) no morphine; (3) combat shock; (4) combat increased intracranial pressure by (a) magnesium sulphate, (b) hypertonic glucose solution intravenously, (c) lumbar drainage; (5) prevent dehydration; (6) prevent starvation; (7) local treatment, (a) scalp wounds, compound fractures, (b) discharge from ear and nose (sinuses), (c) other injuries; (1) fracture through the sinuses, (2) fracture of the jaws, etc.

Dehydration methods are based on the fact that hypertonic solutions will withdraw fluids from the body tissues into the blood stream by a process of osmosis. In doing this, the brain is likewise depleted, thus lessening the increasing edema which has followed the cerebral injury. This method is considered new, yet old writers on skull fractures advocated rest and purging of the patient as the proper line of treatment.

Magnesium sulphate 4 ounces, 50 per cent solution is administered as retention enema and repeated every four to six hours during the first forty-eight hours. Glucose, 50 cc. 50 per cent solution or 100 cc. 25 per cent solution intravenously (sterile) may be repeated every eight or twelve hours. Glucose may be given during the shock period. During the first forty-eight hours, fluid intake is restricted; after forty-eight hours fluids may be pushed.

The remaining cases are treated as follows:

Concussion. There being no signs or symptoms of cranial pathology, except total unconsciousness, after recovery is complete and all symptoms have disappeared, treatment other than rest in bed and supportive care is neither indicated nor required.

Edema and Congestion. Treatment is directed to shrinking of the brain by dehydration or the removal of the excess of backed-up cerebrospinal fluid by lumbar drainage. Dehydration may be carried out by intravenous injection of hypertonic glucose solution or magnesium sulphate by rectum. With lumbar puncture, enough cerebrospinal fluid is removed to reduce an abnormally high pressure to normal limits. This should be repeated every twenty-four hours until two successive normal pressure measurements have been obtained previous to withdrawal of any fluid.

Contusion and Laceration. Treatment is best carried out by a judicious combination of dehydration and lumbar drainage. Munro[3] states that dehydration alone is inefficient in these cases in exact ratio to the amount of free blood in the cerebrospinal fluid. This is due to the mechanical blockage of the arachnoidal villi by the free red blood cells. Operative decompression as a therapeutic measure is contraindicated.

Exploratory trephination, however, can be properly employed as a diagnostic measure whenever the patient fails to improve after a suitable interval of properly executed nonoperative treatment such as outlined above.

Cerebrospinal rhinorrhea may, however, prove to be very serious. It is not uncommon in frontal sinus fractures[5] and is due invariably to a fracture of the cribriform plate[4] in which a funnel-shaped fragment of the dura and arachnoid has been caught in the fracture line. Munro[4] believes fatal meningitis is a certainty unless the fistula

is closed. Packing, irrigation or blowing of the nose should be forbidden.

Fractures involving the frontal sinuses only form a small percentage of our total cases.

Guardigian and Shawan,[5] in a series of 2,600 cases of skull fractures, found an incidence of 5.0 per cent of frontal sinus involvement. The majority of these were asymtomatic and recovered under conservative treatment. Where the posterior wall was involved with threatening intracranial complications operation is indicated.

Fig. 1. Photograph of *x*-ray film showing fractures involving the posterior wall of both frontal sinuses, the cribriform plate, the outer angle and the floor of the left orbit, the left malar, both maxillae and a fracture of the mandible at the symphisis.

CASE REPORT

A white male accountant, age thirty-one, while walking was struck by a moving automobile on November 14, 1937. He lost consciousness immediately and was not clear as to the details of the accident, but apparently he was unconscious for the greater part of the night of November 14 and 15. He was taken to a nearby hospital on the morning of November 15 in a dazed and semiconscious condition and bled profusely from the mouth and nose. On November 16, he was admitted to the Aural Service of the Boston City Hospital.

The examination was as follows: The patient was semiconscious and incoherent. T.P.R., 100.2°C. rectally, 84, 12 B.P. 136/62. The head is described below. The right pupil reacted sluggishly. Extraoccular movements appeared normal. The fundus of the right eye (which was the only one that could be examined), showed no choking. The ear drums were normal; the abdomen was soft; the bladder was enlarged somewhat; the inguinal region and genitalia were negative. Rectal examination showed a scar, presumably from an ischeorectal abscess, to the right of the anus. Prostate was normal. There was some feces in the rectum. The arms and legs showed the lacerations described below. Pulses were normal; reflexes were hyperactive and equal. There was left ankle clonus but no Babinski

or Hoffmann. Abdominal reflexes were not obtained.

The patient's past history was irrelative except for an operation for an ischeorectal abscess a year before.

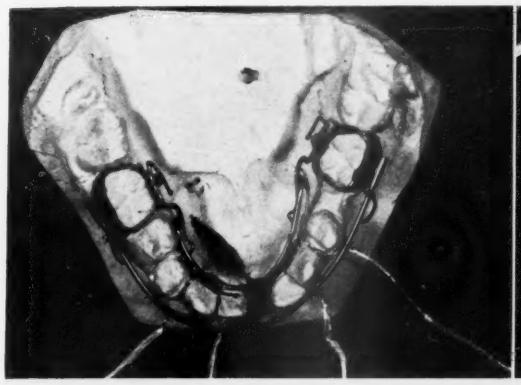

Fig. 2. Plaster model of lower jaw with orthodontia appliances in place. Note the teeth ligated to external arch wire and the expanding arch on the lingual surface.

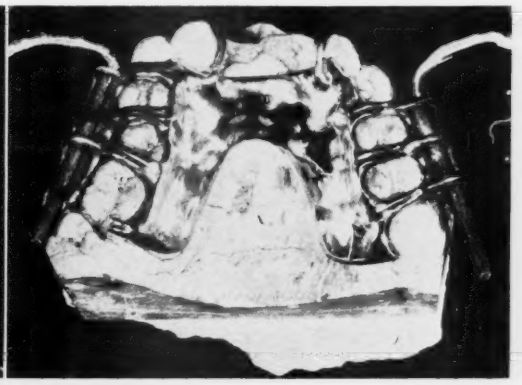

Fig. 3. Plaster model of upper jaw with cast metal plate and side arms in place.

There was a ragged laceration of the chin and a through-and-through laceration of the lower lip. The lower teeth were loosened and the lower right central incisor was missing from an open socket which had a purulent discharge. There was a compound fracture of his lower jaw through the mucous membrane of the mouth and gums; the fracture line was just to the right of the midline. The entire jaw was markedly swollen, the upper and lower lips were lacerated, and there was considerable drooling of blood and saliva. The upper jaw was loose, displaced downward and both central incisors were fractured at their gingival margins. Occlusion was impossible. The tongue was markedly swollen. The patient was unable to swallow. There was induration and swelling in the right submaxillary region extending to the midline with areas of tenderness over the thyroid cartilages. The nose was swollen, bleeding and displaced toward the right with a depressed fracture of the nasal bones and the ascending process of the maxilla on the left side.

Anterior rhinoscopy showed marked congestion of the entire nasal mucosa; the septum was displaced toward the right side; the turbinates were engorged and soggy looking, there was considerable discharge of mucus, blood and cerebrospinal fluid. Posterior rhinoscopy was impossible because of the enormous swelling of tongue and downward displacement of the maxilla. The soft palate and uvula were markedly edematous. There was laceration and abrasion over the upper eye lids with subconjunctival haemorrhage in both eyes. There was considerable swelling at the outer edge of the left orbital border merging with the malar bone on that side.

X-ray examination revealed the following: Left stereo and A.P. of the skull showed multiple fractures: (1) through the posterior wall of both frontal sinuses; (2) through the cribriform plate; (3) through the outer angle of the left orbit; (4) through the floor of the orbit into the left antrum; (5) through both maxillae, more on the left with commutation of the wall of the antrum; (6) through the mandible in the right cuspid region. (Fig. 1.)

Diagnosis. Multiple fractures of the skull including fractures through the cribriform plate and posterior wall of both frontal sinuses with compound fracture of upper and lower jaw; concussion and edema of the brain.

Treatment of the Craniocerebral Injury. The nonoperative procedure was carried out. There was no intracranial pressure, since there was constant discharge of cerebrospinal fluid through the fractured cribriform plate and, therefore, treatment of this complication was not indicated.

Treatment of Lower Jaw. With intermaxillary elastics attached to orthodontia bands on the incisors, both halves of the lower jaw were kept in proper alignment. When the correct alignment was obtained, the orthodontia bands were converted to a retention appliance by uniting them with a soldered bar. The object of the appliances is to reduce the displacement of the fragments, to obtain correct alignment of the teeth and maintain the space of the missing central incisor. Without the

retention appliances there would very likely be contraction of the mandible at this point resulting in a V-shaped arch and hopelessly distorted normal occlusion. An external expanding orthodontia appliance[6] and an internal expanding appliance[7] were adjusted and ligated to the teeth of the lower jaw. (Fig. 2.) The Mershon arch was left in place for eight months to act as a retention appliance after union took place and after the Angle arch was removed.

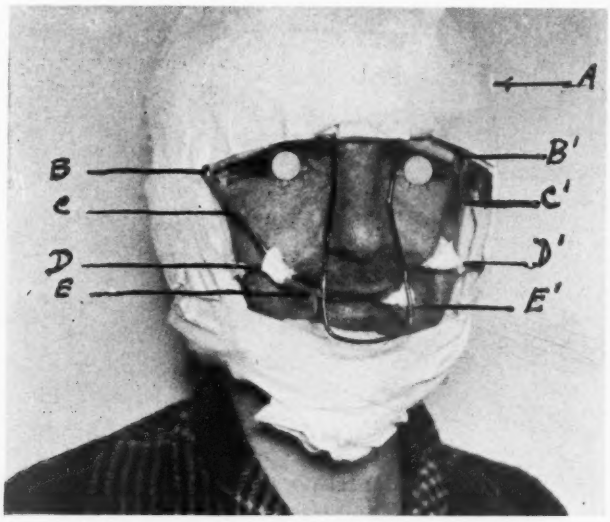

FIG. 4. Plaster cap with attachments. A, plaster cap; B-B', hooks imbedded in plaster; C-C', elastics for upper jaw traction; D-D', wire arms in sleeves of upper plate; E-E', extension for forward traction of lower jaw.

Treatment of the Upper Jaw. A metal plate was constructed with side sleeves for the insertions of heavy wire arms. The plate was now placed into the mouth and the side arms, made of heavy coat hanger wire, were inserted into the sleeves of the plate. By means of heavy elastics the side arms were attached to hooks imbedded in a previously applied plaster cap around the head. The mandible, likewise, by means of heavy elastics was pulled upward and attached to a steel arm imbedded in the plaster cap. (Figs. 3 and 4.) With these appliances in place, and not withstanding the multiplicity of the fractures the patient was able to masticate semisolid foods at the end of four weeks. Through all this period, normal occlusion was maintained.

Complications. On November 26, 1937 an abscess in the submaxillary region was opened and drained. On December 1, 1937 an abscess in the submental region was likewise opened and drained. Irrigation of the left antra resulted in a return of some fresh and old blood. No attempt was made to do any intra- or extranasal operations. It is noteworthy that at no time did the patient complain of headaches. Since there was ample drainage of cerebrospinal fluid through the fractured cribriform plate, it is logical to assume that headache from increased intracranial pressure was thereby removed. Indeed, on only two occasions was any appreciable quantity of fluid obtained by lumbar puncture. This was on the third and fourth days after his admission to the hospital. Two other lumbar punctures done on the seventh and ninth days after admission yielded a small amount of clear fluid.

SUMMARY

1. A statistical analysis of 4,100 cases of fractures of the skull is submitted.

2. An outline of the nonoperative treatment of craniocerebral injuries is presented.

3. Report of a case of multiple fractures of the skull with cranial involvement complicated by compound fractures of the upper and lower jaw is given. The treatment of the jaw complications with orthodontia appliances is described in detail.

4. In spite of fracture through the cribriform plate and the posterior wall of both frontal sinuses with marked rhinorrhea and cerebral edema, the patient made a com-

plete recovery under conservative management as described.

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Once heart failure develops during pregnancy, the patient must be kept in hospital or under hospital conditions till delivered.
From—"The Heart in Pregnancy and the Childbearing Age"—by Burton E. Hamilton and K. Jefferson Thomson (Little, Brown and Co.).

HYPERTHYROIDISM IN ELDERLY PATIENTS*

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HYPERTHYROIDISM in elderly individuals is not an infrequent finding in a large group of patients with cardiac symptoms. The diagnosis is frequently missed because, first, the teaching has been that toxic goiter is a disease of the young and middle age, and second, symptoms of hyperthyroidism in the aged are often different from those found in the young.

The majority of patients over sixty years of age with hyperthyroidism have adenomatous goiters. Plummer has shown that adenomatous goiter is present from fifteen to seventeen years before toxicity develops unless provoked by the indiscriminate use of iodine.

In a study of eighty patients over sixty years of age with hyperthyroidism, the cardinal feature was that they were not stimulated to the degree that a like group of younger patients would be. This feature accounts for their less dramatic symptoms. It may be that the older patients have been overstimulated so long by the overactive thyroid that they have become less responsive.

The constant finding in the entire group was weight loss. It varied from a few pounds to practically half the normal weight. As a rule the weight loss extended over a period of one to four years. A normal or excessive appetite was noted in the activated group, whereas, in the nonactivated cases the appetite was often poor.

Cardiac complaints with palpitation and weakness on exertion were the next in order of frequency. Anginal symptoms were frequently noted. Most of the group had been treated for varying periods of time for heart trouble with practically no response to the treatment. Auricular fibrillation was a frequent finding. The heart sounds were loud and sharp and often there was a mitral systolic murmur present. The systolic blood pressure varied from 150 to 260 mm. of mercury. The diastolic pressure was not raised in proportion to the systolic pressure. The pulse pressure was markedly elevated in all cases. The pulse rate varied from 88 to 130. Most of the patients had taken digitalis over a long period of time with little response, particularly to auricular fibrillation when it was present. Some of the cases had cardiac decompensation and eight were not improved sufficiently by medical measures to attempt surgical relief. In the cases in which auricular fibrillation was not present, the use of digitalis did not prove to be of any assistance.

The patients in the activated group were sensitive to heat; their skin was warm and moist, and seldom was pigmentation noted; whereas, in the nonactivated group the skin was without tine, was dry and cold. Pigmentation was frequently noted in this latter group.

Among the patients with marked weight loss, gastrointestinal symptoms were observed with crises of vomiting and diarrhea. Many of the latter had been studied for gastrointestinal malignancy.

Eye findings were not constant. A few cases had exophthalmus (Fig. 1), but they were patients that gave a history of having developed exophthalmic goiter earlier in life and were what Hertzler[1] termed "burned out individuals." Stare was occasionally seen in the activated but not in the nonactivated group.

A psychosis is more frequently seen in the older group of cases and is often ascribed to senile dementia.

The entire group complained of muscle weakness and were easily fatigued. This

* Read before the American Association for the Study of Goiter, Rochester, Minnesota, April 15–17, 1940.

was out of proportion to their age and frequently led to the diagnosis of heart trouble. Digital tremor was seen but was not a constant finding.

Fig. 1. Apathetic hyperthyroidism. Low basal metabolic rate and auricular fibrillation present. Pulse 144, auricular fibrillation. Basal metabolic rate, +14. Many years' duration.

The basal metabolic rate as a rule was elevated but not to the degree found in younger individuals. Two years ago I reported a group of toxic cases[2] with basal metabolic rates within normal limits. Several of the cases included in that group are reported here. In the nonactivated or apathetic group as designated by Lahey,[3] the basal metabolic rates were around plus twenty.

There was a very definite goiter present in every patient. Some had rather large adenomatous goiters. In the cases that had taken iodine over a long period of time, the gland was hard and firm, often simulating a malignancy. Intrathoracic extensions were noted in a few cases.

Frequently cases are encountered that have progressed to such an extent and the

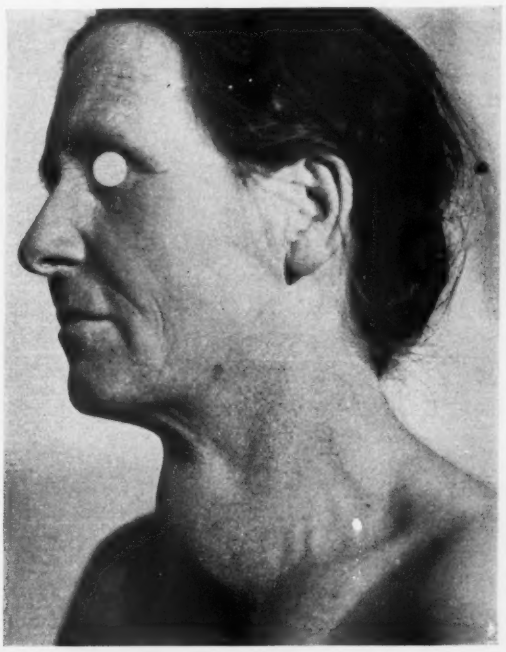

Fig. 2. Large cervical goiter, also large intrathoracic goiter. Pulse rate 120. Auricular fibrillation present. Basal metabolic rate, +22.

cardiac damage is so marked, that they can not be corrected surgically. Eight cases in this series were of this type. They did not respond sufficiently to medical measures to attempt pole ligation and all expired within a period of a few months.

The older group requires very meticulous preoperative care. Frequently they have other complications, such as old rheumatic hearts, generalized arteriosclerosis, impaired renal function and prostatic hypertrophy with retention, any of which add an additional burden to the hyperthyroidism. Most of the cases that had a diagnosis of hyperthyroidism made previously had taken iodine from a few months to several years. Such cases are iodine fast. If the iodine had not been administered, they could have been prepared much easier and with a larger margin of safety. It is often surprising how much can be done for those individuals with evidence of severe heart

disease when they are carefully prepared and are operated upon in stages. A high carbohydrate diet, Lugol's solution, digitalis if auricular fibrillation is present and diuretics in the presence of edema are given.

When the patient is first seen a preliminary evaluation of the risk should be made, because at no other time can this be done so advantageously. After the patient has been at rest with sedation and Lugol's, it is almost impossible to judge the proper time for operative interference without knowledge of the original status of the patient. In determining the status of a patient we have in addition to a complete physical examination with routine laboratory work, a stereo of the chest (Fig. 2), an electrocardiogram and blood chemistry determinations if there is any indication of renal impairment.

In particular we consider the pulse rate after bed rest of six to eight days, the length of time the disease has been present, whether iodine has been previously administered, and last, but not least, the weight loss and the rapidity of the same. Preoperatively we follow the preparation of the patient by the change of these factors and not by the lowering in the basal metabolic rate.

It is in older people that stage operations can be used most advantageously. If there is any doubt about the risk, one lobe is removed, the patient is permitted to recuperate at home six to eight weeks and then the other lobe is removed.

Local anesthesia, with light analgesia of gas, helium and oxygen, was used. These patients tolerate deep anesthesia very poorly. Furthermore, they do not tolerate large doses of barbiturates as such drugs produce too much depression. Codeine and small doses of morphia are used to relieve pain and restlessness.

Postoperatively the patient, if a poor risk, is placed in an ice cooled oxygen tent for two or three days. Five or 10 per cent glucose in normal saline solution is given slowly up to 2000 to 3000 cc. daily. This provides nourishment, stimulates renal function, takes care of the water balance and prevents acidosis. These measures assist in preventing postoperative thyroid reactions.

Diligent postoperative care must be exercised to prevent pulmonary complications which often end fatally. If too much sedation is administered, the patient is depressed, mucus forms in the trachea, the patient is unable to cough it up and bronchopneumonia develops. Often the patient can readily expell the mucus by having him bend over the edge of the bed or by elevating the foot of the bed.

A study of seventy-two patients who were operated upon was made. These cases were divided roughly into the activated and nonactivated groups.

NONACTIVED OR APATHETIC GROUP
Number of Cases 22

Age	Length of Time Goiter was Present, Years	Blood Pressure	B.M.R., Per Cent	Weight Loss	Postoperative Mortality, Per Cent
Average 67 Oldest 77 Youngest 60	Average 22 Longest 42 Shortest 4	Average 170/90 Highest 240/170 Lowest 148/86	Average plus 28 Highest plus 42 Lowest minus 12	Average 34 pounds	2 or 9.9

ACTIVATED GROUP
Number of Cases 50

Age	Length of Time Goiter Was Present, Years	Blood Pressure	B.M.R., Per Cent	Weight Loss	Postoperative Mortality, Per Cent
Average 66	Average 18 Longest 28 Shortest 3	Average 180/92 Highest 230/130	Average plus 32 Highest plus 52 Lowest minus 8	Average 26 pounds	2 or 4

The operative mortality in the group of patients over sixty years of age was 5.5 per cent. In a large group of cases under sixty years of age the operative mortality was 1.2 per cent.

The following case reports illustrate our management for goiter patients of this age group:

CASE REPORTS

Case I. Mrs. E. W. H., age sixty-eight years, housewife, (Fig. 3), complained of weight loss, palpitation, weakness, choking attacks and nervousness of three years' duration. She stated that a goiter had been present for thirty-five years. She first noticed gradual loss of weight and had attacks of indigestion accompanied by vomiting and diarrhea. She had been treated for colitis, heart trouble and high blood pressure. Examination revealed a markedly emaciated woman, weight one hundred three pounds (normal weight one hundred and sixty-eight), skin moist and warm, pulse rate 138; the heart was fibrillating; blood pressure 240/130 mm. of mercury. There was digital tremor and eye stare present. Her basal metabolic rate was plus fifty-two. Both lobes of the thyroid were nodular and firm. There were no pulsations or bruits. She was hospitalized, put on Lugol's solution, digitalis, high caloric diet and bed rest. After two weeks her pulse rate was 96 and regular, the basal metabolic rate was plus thirty-six, and there had been a gain of six pounds. A bilateral thyroidectomy was done. The patient went into a coma after a few hours and remained stuperous for four days, during which time she was given 3,000 cc. of 5 per cent glucose saline intravenously daily and two transfusions of 400 cc. of whole blood. The pulse rate did not exceed 130. She gradually improved and was dismissed from the hospital on the sixteenth day. One year later the basal metabolic rate was plus six, pulse rate 78, and blood pressure 190/120. She expired in 1938 from apoplexy at the age of seventy-seven, nine years after the operation. This patient would have done better with a two-stage operation.

Fig. 3. Goiter present thirty-five years. Pulse rate 138; auricular fibrillation present; basal metabolic rate, +52.

Case II. Mrs. T. E. E., age sixty-six, housewife, was referred by Dr. E. E. Davis, of Albuquerque, New Mexico. The patient stated

she was referred to Dr. Davis from Indiana for tubercular treatment. She complained of coughing, choking, loss of weight and strength. She was very nervous but had an excellent appetite. Examination: poorly nourished white woman, weight ninety-six pounds (normal weight one hundred and forty pounds), skin moist and warm, digital tremor, lid lag and stare. The right lobe of thyroid was markedly enlarged, nodular and firm. The left lobe was substernal, producing tracheal deviation. The pulse rate was 110, and the heart was fibrillating. Her basal metabolic rate was plus thirty-four. The patient was hospitalized, given a high carbohydrate diet, Lugol's solution and digitalis. After twelve days her pulse rate was 102 and her basal metabolic rate plus thirty-two. A right lobectomy was done. Convalescence was uneventful and she was sent home. After eight weeks she returned. She had improved considerably and had gained six pounds in weight, but still complained of choking. Her pulse rate was 100. The auricular fibrillation had disappeared. The intrathoracic left lobe was removed. No follow-up report was obtainable.

Case III. Mrs. J. E. F., age sixty-nine, housewife, was referred by Dr. W. P. Martin, of Clovis, New Mexico. The patient stated she had smothering attacks, marked loss of strength and weight, poor appetite and attacks of diarrhea and vomiting. Examination revealed an elderly woman with evidence of marked weight loss. Her skin was cool and dry. No digital tremor or ocular signs were present. The thyroid was three or four times the normal size and both lobes were very firm. The pulse rate was 96 and regular. Blood pressure was 160 systolic and 80 diastolic. Moist rales were found over the bases of both lungs, and there was one plus edema of the ankles. The urine showed a two plus albumen, and there were coarse and fine granular casts. Her basal metabolic rate was plus six. The patient was hospitalized, given Lugol's solution, a high carbohydrate diet, and two weeks later a right hemithyroidectomy was done. She was given an immediate blood transfusion, put under an ice cooled oxygen tent, and given 3,000 cc. of 5 per cent glucose saline solution daily by slow drip. She gradually became unconscious. Her pulse rate remained under 100 and was regular. At the end of four days she began to improve and was dismissed on the sixteenth postoperative day and permitted to go to her home. After two months she returned feeling much better and a left hemithyroidectomy was done. She was placed immediately under the ice cooled oxygen tent and given 400 cc. of citrated blood. Her convalescence was without incident. When seen five years later she had regained her former weight and was able to do her own house work. She had lost her apathetic appearance and was again interested in outside activities.

Case IV. A male, age sixty-two, was referred by Dr. H. A. Ingalls, of Roswell, New Mexico. He complained of pain on exertion, shortness of breath, and loss of thirty pounds in weight. He had been treated for angina for the preceding three years. Exertion produced a substernal pain which radiated to the left shoulder and left arm. At first nitroglycerin would give relief. Examination revealed a well nourished man, weight one hundred sixty-two pounds (former weight one hundred ninety-four pounds), skin moist and warm, slight stare and lid lag. Both lobes of the thyroid were markedly enlarged and firm. His pulse rate was 118 and irregular. Blood pressure 180 systolic and 100 diastolic. His basal metabolic rate was plus forty-one. After two weeks rest in bed, a high carbohydrate diet, Lugol's solution and digitalis, his pulse rate was 98 and regular. A right hemithyroidectomy was done. He made an uneventful convalescence and was discharged on the tenth postoperative day. He was requested to return after six weeks for the second lobectomy, but he was not seen again for two and one-half years. When he returned he stated he had felt so well after the first procedure that he did not think any further treatment was necessary. However, lately his former symptoms have returned. Examination revealed his pulse rate to be 106 and regular. His basal metabolic rate was plus twenty-four. He was given preoperative treatment as before, except for digitalis. A left hemithyroidectomy was done. He had marked anginal pain for ten days, then it disappeared. He was discharged on the fourteenth postoperative day and has since resumed his former position. For the past three years he has had no anginal attacks.

CONCLUSION

The diagnosis and management of hyperthyroidism in the younger individual is often difficult. In the aged ones diagnostic

acumen is even more taxed, and only by attention to many details can the elderly patient be carried safely through operation. However, the end results are highly satisfactory and years of life are added. The medical profession, particularly the general practitioner, must be made more aware of the fact that hyperthyroidism can exist in elderly patients and be taught to recognize it as such, for he is the person who usually sees these cases in the beginning. The medical profession in general must become more acquainted with the excellent operative results that can be obtained in a large percentage of these patients.

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In early tubercle formation, . . . the appearance of the gray center of the tubercle is simultaneous with the appearance of allergy. There may be more than allergy, however, because other allergic reactions may not caseate at all.

From—"Age Morphology of Primary Tubercles"—by Henry C. Sweany (Charles C. Thomas).

A REVIEW OF 500 GYNECOLOGICAL PATIENTS WITH URINARY SYMPTOMS*

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THE proximity of the generative and urinary tracts in the female, and the frequency of associated pathology often results in errors in diagnosis and treatment.[1,2] Gynecological conditions frequently present themselves as urological problems, and residual disease in the urinary tract often requires treatment after the gynecological pathology has been eliminated.

At Harlem Hospital a cystoscopic clinic was organized on the gynecological service to study this large group of patients. In about 90 per cent of these cases the pathology was found to be limited to the vesico-urethral junction, which includes the internal sphincter and bladder neck, with extension often, above to the trigone, and below to the urethra.

For purposes of cystoscopic orientation, diagnosis, and therapy, the urinary tract was divided into the following parts: urethra, internal sphincter, bladder neck, and trigone.

Urethra. The female urethra is short and bathed with fecal and leucorrheal discharge and it is, therefore, not surprising that urethral inflammation occurs frequently.[3,4,5]

Actual strictures of the urethra are uncommon, but the lumen is often diminished, necessitating dilatation before a cystoscope can be introduced. Stevens calibrated the urethra of 118 women who had no symptoms, and found the average size to be F26, the smallest F18, and the largest F30. A urethra below F26 is often responsible for symptoms and pathology. Of a total of 1,227 patients with urinary symptoms, Stevens found narrowing of the urethra in 458, or 37 per cent. Early detection and correction of stricture or constriction of the female urethra is important.

Internal Sphincter. Edema or contraction of the internal sphincter, the dividing line between the urethra and bladder neck, is also a common lesion. The mucosa of the internal sphincter is pushed into the lumen of the urethra, projecting around the circumference. When uneven, it appears scalloped, or in the form of well defined polypoid masses or papillary folds which move in the irrigating fluid.

Bar formation, or the raising of the posterior margin of the internal sphincter, is a lesion that has long been underestimated in the female. It appears in the lower cystoscopic field as a barrier which often obstructs the view of the bladder. When the tip of the cystoscope rides over the bar and is depressed, a view of the trigone may be obtained. This condition was first recognized by Mercier, who called it "valvules du col de la vessie."[6] The pathology consists of a dense submucosal fibrosis and sclerosis, which results from previous inflammatory edema.

Bladder Neck. The bladder neck which lies just proximal to the internal sphincter at the apex of the trigone, may be the site of hyperemia, simple or bullous edema, or pseudomembranous exudate. These may be associated with similar conditions of the trigone and internal sphincter. Hyperemia is characterized by an intense uniform redness of the area. Bullous edema consists of groups of pinhead or larger sized whitish or greyish translucent areas. In pseudomembranous edema, a whitish membrane covers the vesical neck and may ex-

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tend over the trigone, with irregular, peninsular-like projections and sharply defined borders.

Trigone. Normally, the surface of the trigone is covered with a fine network of vessels, as compared to the pale yellowish appearance of the surrounding bladder mucosa. This vascularity is often mistakenly considered pathological. Only when there is a marked increase in the number and size of the vessels, approaching a hyperemia, or, if they are obscured by edema, or membranous exudate, should a diagnosis of trigonitis be made. Recently, attention has been called to trichomonas as a possible cause of trigonitis.[7]

ETIOLOGY

There is unquestionably a definite relationship between pelvic infection and disease of the vesico-urethral junction. The close anatomical relationship between the base of the bladder and the anterior surface of the cervix up to the level of the internal os, allows direct extension of an infection from the cervix. Winsbury-White injected India ink into the cervices of guinea pigs, and found the particles traveled directly beneath the trigone and bladder via the lymphatics.[8]

Circulatory, neurological and psychic factors also play a role.[9] Congestion of the pelvic organs, due to menstrual disorders, coitus interruptus, etc., produce trigonitis because of the intimate relationship between the venous, lymphatic and nerve plexuses of the two tracts.

Psychic factors such as marital maladjustment, fear of pregnancy, and the menopause play an important rôle in the genesis of urinary symptoms. Deliveries are of importance in the production of bladder symptoms because of destructive injuries to the supporting structures and sphincteric muscles. Low grade infections of lacerated cervices also result, which may be transmitted to the trigone.

Surgical trauma should also be considered, as it is quite likely that mobilization of the bladder from above or below may occasionally interfere with its innervation and vascular supply and produce local symptoms.[10,11]

SYMPTOMATOLOGY

Identical symptoms are often produced by lesions located at any point between the extreme levels of the urinary tract. Frequency, nocturia, burning, urgency and incontinence, or a combination of any of these, are the common symptoms. Nocturia is an important index of the intensity of the symptoms, whereas diurnal frequency is often a manifestation of general nervousness.[12] Usually no gross pathology is found to account for the symptoms except changes in the vesico-urethral junction often missed in the search for diseases of the kidneys, ureters or bladder.[13]

In the history, incontinence and urgency must be differentiated. In the former there is involuntary passage of urine and, in the latter, the desire to urinate must be immediately satisfied.

Hematuria is not a common symptom and is usually due to gross urological lesions.

Referred pain in the lower back is rather common. This may be due to trigonitis, but is primarily caused by the associated pelvic pathology.

DIFFERENTIAL DIAGNOSIS

Most cases of irritable bladder neck and urethral inflammation in the female are diagnosed as "cystitis." This blanket diagnosis of cystitis has been assiduously avoided here. The diagnosis of cystitis should be sharply limited to those cases in which the inflammatory process extends beyond the trigone to the bladder walls.[14] In cystitis, the urine usually contains pus, which calls attention to complaints of these patients, resulting in early urological study.[15] Disturbances in the urethra and bladder neck may cause marked urinary symptoms in the presence of a negative urine.[16] Therefore, a negative urine should not preclude careful cystoscopic examination with particular attention to this

area. Concentration on the inflammatory changes found here should not, however, lead to the neglect of other gross urological lesions which may co-exist. In this series less than 10 per cent had complicating gross urological lesions.

TREATMENT

If one is able to classify the urological symptoms occurring in the female and correlate them with the anatomical, pathological and cystoscopic findings, a standardization of treatment based on the pathological and cystoscopic findings becomes possible. Bladder irrigation and instillation therapy is the usual treatment given to most female patients with urinary symptoms. When relief is not obtained after long periods of such treatment, these patients are often unfortunately classed as neurotics. The various changes that occur in the vesico-urethral junction have a similar etiology, produce largely the same symptoms and often respond to the same therapeutic measures. This is often confirmed clinically when appropriate treatment of the cervix causes disappearance of urological symptoms. Similarly, eradication of other pelvic inflammation produces relief of urinary symptoms.

All patients are instructed to take hot douches and hot sitz baths daily, as the heat and hydrotherapy helps alleviate urinary distress and reduces pelvic inflammation. Frequently, this alone, or with the administration of simple sedatives (bromides, luminal, etc., or tincture of hyocyamus) relieves the symptoms, particularly in mild congestion of the trigone or bladder neck, caused by pelvic inflammation.

Relief of mental tension with sedatives may relieve urinary symptoms which are often present, despite the absence of any local pathology. This is particularly true in menopausal cases in which the addition of estrogenic hormone also improves the local atrophy.

In the treatment of hyperemia of the trigone, correction of the pelvic disease may, in itself, eliminate all symptoms.[17] If the usual hydrotherapy is not sufficient, Kelly treatment may be instituted. This consists of the topical application of 1 to 5 per cent silver nitrate, through an endoscope, with the patient in the knee chest position and the bladder empty. Where there is associated edema of the bladder neck, Kelly treatments may be used but should be accompanied by dilatation.

In cases of diminished capacity of the bladder, due to a chronic cystitis or to extravesical pressure, hydraulic distention of the bladder is of value.

When a cystitis is also present, e.g., the inflammatory process has extended beyond the trigone or base of the bladder, bladder irrigations of boric acid, acriflavine or other antiseptics are given, followed by instillation of argyrol, 10 per cent.

When a diminished caliber of the urethra, or disease of the internal sphincter and bladder neck is found, introduction of various sized Hegar or Hank's dilators, past the internal sphincter is specific. Treatments should be given weekly, gradually increasing the caliber of the dilators until a 10 or 11 Hegar or 28F or 30F French sound is reached. Usually, no more than six to nine treatments are necessary with the largest sized dilators. Gentle massage over the sound with the finger in the vagina has been found of value. Often the symptoms subside following the first treatment, which may explain the cessation of symptoms that often follows a simple cystoscopy. Since involvement of the urethra and bladder neck were found so commonly, dilatation of the urethra was almost always necessary.

In cases of actual urethral stricture, when the caliber is so small as to barely admit a No. 4 ureteral catheter, bougies can be used, until the caliber of the urethra permits the passage of sounds. When bar formation is found, dilatation almost always gives prompt relief as this edematous area recedes with dilatation. Occasionally it may be necessary to employ the high frequency current to cut through the bar

or to destroy polypoid formations of the internal sphincter, but in either case, dilatation should follow.

A detailed analysis of 500 consecutive cases with urinary symptoms from the cystoscopic clinic of Harlem Hospital, and from the wards of the gynecological service, from which the above conclusions were reached, is presented.

Age:
Average age: 35.6 years
20 to 40 years: 300 or 58 per cent
40 or over: 176 or 13 per cent
Menopause: 108 or 31 per cent
a, surgical: 41 or 18 per cent
b, spontaneous: 67 or 13 per cent
Marital status:
Married: 410 or 82 per cent

A large number, 175 or 35 per cent, complained of being nervous and irritable, due, among other causes, to marital maladjustment and fear of pregnancy.

Gravidity:
Gravid: 385 or 77 per cent
Parous: 315 or 63 per cent
Endocervicitis: 170 or 34 per cent

The importance of gravidity with its consequent trauma including endocervicitis, in the production of bladder symptoms, has been emphasized. The occurrence of cystocele, urethrocele and prolapse, was remarkably rare in this series. The great majority of the patients treated in this hospital are colored. The fascia and musculature of the female negro are very strong and elastic which explains the rare necessity of pelvic repair for prolapse or incontinence.

Surgical History. Gynecological operations: 90 or 18 per cent (usually for fibroids, pyosalpinx, or tubo-ovarian abscess). There were no unusual changes in the bladders of these patients, as is sometimes found after mobilization of the bladder in plastic repair. There was a history of the latter in only three cases, in which the pathology found, bore no relation to the surgical procedure.

	No.	Per Cent
Symptomatology:		
Frequency	360	72
Burning urination	190	38
Urgency	225	49
Incontinence	95	19
Hematuria	35	7
Backache	225	51

	No.	Per Cent
Duration of symptoms:		
2 weeks to 6 months	230	46
6 months to 1 year	100	20
1 year to 5 years	115	23
Over 5 years	55	11

Of considerable significance is the fact that 170 or 34 per cent had symptoms for more than a year before proper urological investigation was done.

Although the following table gives the frequency and the type of pathology found, there is considerable overlapping, as many cases had a combination of several types.

CYSTOSCOPIC FINDINGS IN 467 PATIENTS

	No.	Per Cent
Vesicourethral junction, urethra and trigone:		
Edema of bladder neck	345	74
Edema of internal sphincter	280	60
Bar formation	70	15
Polypoid or villus formations	57	12.2
Relative stricture of urethra	84	18
Hyperemia of trigone	205	44
Edema of trigone	53	11.3
Acute cystitis	22	4.7
Caruncle	7	1.5

The following cases though not discussed were associated with gynecological pathology.

	No.	Per Cent
Vesicovaginal fistula	3	.7

Ureteral obstruction with dilatation of the ureters and calyces:

	No.	Per Cent
By fibroids	18	4
By adnexal masses	12	2.9
By parametritis	5	1.0
Rupture of pyosalpinx into bladder	2	.43
Laceration of bladder in hysterectomy	1	.2

	No.	Per Cent
Primary gross urological disease:		
Nephroptosis	6	1.3
Carcinoma of bladder	2	.43
Hypernephroma	1	.2
Polycystic kidneys	3	.7
T.B. Kidneys	2	.43
Calculi of bladder	1	.2
Pyonephrosis	1	.2
Ureteral calculi	2	.43
Pyelonephritis	2	.43

Of the 467 cystoscopies, only 25 or 4.97 per cent revealed primary major urological lesions. If urethral caruncle and acute cystitis were included, the total is 54 or 11.17 per cent.

Treatment: Other than the unusual and major urological cases requiring special treatment, the remainder, 428 patients were treated as follows:

	No.	Per Cent
Dilatation of the urethra	312	73
Bladder irrigation with instillation of argyrol (acute cystitis)	22	5
Hot sitz baths and douches only	94	22

Results of Treatment: Of the 428 cases treated by methods above, results are unknown in 64, leaving 364 cases.

	No.	Per Cent
Improved	214	59
Cured	117	32
Not improved	33	9

No patient was pronounced cured until there was complete cessation of urinary symptoms. A patient was classified as improved when there was a definite diminution of the major urinary symptoms.

SUMMARY AND CONCLUSIONS

1. Urinary symptoms in the great majority of female patients have their origin in the vesico-urethral junction.

2. The female patient with urinary symptoms should have a meticulous examination of the urethra, bladder neck and bladder.

3. The correction of gynecological disease and abnormal physiological changes is frequently followed by alleviation of the urological symptoms.

4. The patient's history particularly regarding menopause, marital status, mental health, age and other factors are important in the consideration of treatment.

5. Dilatation of the urethra is of definite value in the treatment of diseases of the vesico-urethral junction.

6. Hydrotherapy, general hygienic measures and proper sedation should accompany local treatment.

7. The term, "cystitis," so frequently used as a diagnosis to cover urinary symptoms, should be replaced by that applicable to the specific pathology found.

8. The gynecologist should have proper training in cystoscopy and also endoscopy of the urethra.

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STUDIES IN URINARY ANTISEPSIS*

CLINICAL INVESTIGATION OF MANDELAMINE, A RECENTLY INTRODUCED URINARY ANTISEPTIC

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THE search for the perfect urinary antiseptic has been a long one. Twenty years ago, Davis described the ideal as a bactericide for internal use which would be chemically stable, nontoxic in therapeutic doses, would not irritate the urinary tract mucosa, would be bactericidal in high dilution of urine of any reaction and capable of being excreted practically unchanged in full amount by the kidneys. But he added sadly, "There is no such drug known."

However, during the two decades which have elapsed since this pessimistic utterance, considerable progress has been made. The ketogenic diet was first instituted in 1917, but it was not until 1931 that its use to render sterile the urine of urologic patients was made practical by Helmholz and others. But after exceptionally wide clinical trial it was realized that the usefulness of the method was definitely limited. In many cases of severe prostatitis, even when the diet reduced the ordinary pH of the urine to a satisfactory level, and the beta-oxybutric acid was adequately concentrated, the organisms in the urine were not eliminated. It was evident that a change in the reaction of the urine was not the only factor necessary to inhibit bacterial development.

Because of his dissatisfaction with the results obtained by use of the ketogenic diet, Rosenheim began using mandelic acid —a dosage of 12 Gm. daily, combined with 8 Gm. of ammonium chloride and a fluid intake of one quart (32 ounces). This dosage usually kept the pH of the urine below 5.5 and was to that extent very satisfactory. But so many patients were unable to tolerate the drug that the same objections urged against the employment of methanamine and the ketogenic diet were again brought to bear to discourage the use of mandelic acid as a urinary antiseptic.

It had several times occurred to the present writer and, as later appeared, to many other workers in the field of urinary pathology, that if methenamine and mandelic acid might be combined, the advantages presented by each might be retained and their drawbacks eliminated. In 1938 and 1939, workers at the University of Minnesota and elsewhere, demonstrated that such a combination was chemically possible, and showed that the combination was bactericidal in varying concentrations at different pH levels. Even before this, Tisza had attained a similar chemical combination, and had shown *in vitro* that methenamine mandelate in sufficient concentration is effective against staphylococcus, streptococcus and the colon bacillus. When enthusiasm over the use of sulfanilamide was rapidly increasing, the importance of this work was not fully realized; but with the discovery that indiscriminate use of the sulfonamides was fraught with many dangers, attention was once more focused on improvement in already existing agents.

The chemical combination of mandelic acid and methanamine is methenamine mandelate whose structural formula is shown in Figure 1. Methenamine mandelate is very soluble in water, alcohol, acetone, chloroform and in hot benzene, less so in cold benzene solution, but is

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insoluble in ligroine. The melting point of methenamine mandelate is 128° to 130°c. It is a new chemical entity and an analysis of

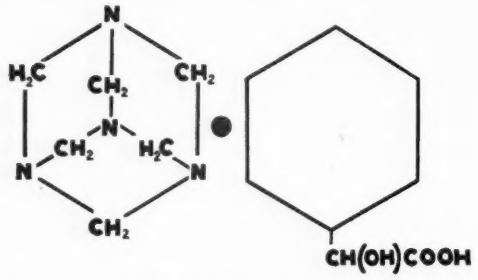

Fig. 1. Methenamine mandelate, mandelamine.

the clinical results shows that it cannot be regarded as just another mixture of mandelic acid.

In the author's service at City Hospital, Welfare Island (New York City) adequate urinary antisepsis is an ever present clinical problem. When it was brought to our attention that a chemical combination of mandelic acid and methenamine was available,* it was decided to give it an extensive clinical trial, as it was in line with views long held by the author. Complete studies on sixty-three cases are now available for report; a much larger number cannot be included because, owing to the shifting character of our clientele, it is frequently impossible to follow up the individuals long enough to permit drawing adequate conclusions.

The different conditions under treatment are shown graphically in Table 1. It will be seen that simple cystitis was of most frequent occurrence, with the bladder inflammation accompanying prostatic hypertrophy furnishing the next greatest number of cases. The prevailing organisms were Bacillus coli, streptococcus and staphylococcus. The average dosage was three tablets three times daily, each tablet containing 0.25 Gm. methenamine mandelate. The total daily dosage is therefore 2.25 Gm. methenamine mandelate, mandelamine, of which 1.18 Gm. are mandelic acid and 1.07 Gm. are methenamine by analysis. A few patients received as much as three tablets, four times daily, but even with this dosage —the maximum—no toxic manifestations were in evidence. At no time did any patient suffer the nausea, vomiting, or other gastrointestinal disturbances which had occurred so frequently in the past when other urinary antiseptics were being employed.

* Methenamine Mandelate, Mandelamine, used in this study was supplied through the courtesy of Nepera Chemical Co., Inc., Yonkers, N. Y.

Table 1

Cystitis	18
Pyelitis	10
Cystitis with prostatic hypertrophy	14
Pyelitis with prostatic hypertrophy	5
Pyelonephritis	8
Pyelonephritis with stone	1
Urethral calculus with cystitis	1
Urethral fistual with cystitis	1
Kidney stone with pyelitis	1
Hydronephrosis with cystitis	1
Carcinoma of the prostate with cystitis	2
Suprapubic cystotomy with cystitis	1
Laboratory routine studies:	
(a) Culture of urine every second day	
(b) Determination of urinary pH on each specimen	
(c) Microscopic examination of urine specimen daily	

Results. Of the sixty-three patients whose cases are here discussed, fifty-four or 83 per cent showed definite improvement under the medication. In twenty-four cases the urine cleared, with negative cultures for Bacillus coli, Staphylococcus albus, and nonhemolytic streptococcus (the various organisms previously demonstrated) within three to five days. In twenty-eight cases the urine cleared and the cultures became negative after more extended trial. In four patients the improvement was questionable, and in four cases the medication was quite without effect. Two of these last mentioned patients died of intercurrent disease while the treatment was in progress.

Some of the more noteworthy histories may be very briefly summarized:

CASE REPORTS

Case 1. M. D., a male, had prostatic hypertrophy, pyelitis and cystitis. His chief complaint was frequency and burning. The duration of symptoms was four months. The

culture obtained was streptococcus, Bacillus coli and mixed bac. Mandelamine dosage consisted of three tablets, three times daily. The third culture showed no growth; frequency and pain disappeared, and the nocturia was greatly improved after the fourth day of medication. He was on regular diet throughout, with absolutely no gastrointestinal disturbance.

Case II. F. L., a male, forty years old, had cardiac decompensation, and prostatic hypertrophy of six years' duration. His chief complaint was difficulty of urination. Under regular dosage of mandelamine the urine cleared on the third day, the previous foul odor disappeared and there was less frequency. There were no toxic symptoms of any description.

Case III. A woman of 80 years, had a fractured right femur, pyelitis and cystitis. Her chief complaint was urgency. At the first examination the urine was negative, but on the fifth day after the accident, Bacillus coli appeared. Under regular dosage of mandelamine, the urine cleared on the third day after medication started, and the general condition was much improved by the fourth day. There was no toxic reaction at any time.

Case IV. C. S., a male, aged seventy-nine years, had cancer of the prostate with associated cystitis and much pus in the urine. His chief complaint was frequency. Under regular mandelamine administration the general condition improved and there was clearing of the urine by the fourth day of medication, the reaction was negative on the sixth day and pain was greatly lessened. In this inoperable condition in an aged patient, the greatest benefit was derived from our ability to control the urinary infection.

Case V. L. J., a male, aged fifty-one years, entered the hospital because of acute retention, giving a history of urinary difficulties extending over some ten years. Examination revealed a tight stricture of the urethra as the cause of retention. The urine was loaded with pus and culture revealed Streptococcus and Bacillus coli. In connection with urethral dilatation, mandelamine administration in regular dosage was instituted. The urine cleared in four days, but Bacillus coli continued to be demonstrated until the twenty-third day, following a second dilatation. Throughout the long course of medication required by this peculiarly obstinate infection mandelamine was perfectly tolerated, producing no toxic manifestations of any kind.

CONCLUSIONS

In the combination of mandelic acid and methenamine, such as is presented in mandelamine, methenamine mandelate, a new urinary antiseptic to which clinical trial has been given in the author's service at City Hospital, Welfare Island, New York, we now have an efficient and reliable urinary antiseptic which bids fair to fill a want long acutely felt in urologic practice. The results attained in sixty-three cases upon which full data were available, conclusively show that with this medication no toxic effects are manifested, and that the patient may remain on regular diet throughout the entire period of administration, provided he has no physical condition which would forbid it. In obstinate cases in which the medication must be long continued, this combination has proved especially valuable, as it produces none of the toxic effects which limited the usefulness of the older drugs from which it is derived, no matter how long its use is continued.

SUMMARY

Although mandelic acid and methenamine have both been used extensively as urinary antiseptics, their toxic effects, particularly in long continued administration, have seriously limited their employment.

The chemical combination of these two drugs having been found practical, the author made use of mandelamine, a recently introduced form, in the treatment of patients seen in the urological service at the City Hospital, Welfare Island, New York.

In sixty-three cases in which full data were available, excellent results were obtained. An average dosage of three 0.25 Gm. tablets, three times daily, readily controlled most of the common urinary infections, maintaining a urinary acidity below 6.0 without the use of any accessory acid administration. In the majority of the patients the urine cleared within three to five days, and such symptoms as frequency

and urgency were reduced or entirely eliminated.

None of the patients at any time manifested toxic symptoms. This demonstrates that the effectiveness of methenamine as a urinary antiseptic has not been impaired by its chemical combination with mandelic acid, although the nausea, vomiting and other gastrointestinal disturbances induced by high dosage of mandelic acid have been eliminated.

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. . . the usefulness of ordinary roentgenology is decidedly restricted in dealing with vascular diseases. In order to obtain more information in reference to the efficiency of the circulation and anomalous structures, visualization of the arterial tree is necessary.
From—"Peripheral Vascular Diseases"—by Kramer (Blakiston).

THE SIGNIFICANCE OF BLEEDING PER RECTUM

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THE rectum and colon have long been the happy hunting ground of quacks and charlatans. Magazines and newspapers can be found in all sections of the country in whose columns are advertisements for "Pile Cures," "Rectal Massagers," "Colonic Lavage Treatments," "Electro-Tonic Method," "Dilators" and "Rectal Clinics," all of which contain the highest self-praise imaginable for the particular nostrum or "clinic" which is being touted. It seems incredible that many of our citizens can be made to accept the trash that is handed out to them in such brazen fashion and in such copious amount. I have recently discussed quacks and charlatans more fully in an article which appeared in the March issue, 1941, of *Hygeia* under the title, "The Sure-Cure Racket."

Modesty is a questionable virtue when one has bleeding from the rectum. Curiously enough, a patient who would not hesitate to see an ethical physician when stricken with pneumonia, will slink up the back stair of the local hotel to be injected for hemorrhoids by a travelling quack or self-styled "professor of rectal diseases." I saw one such patient a short time ago. She was a gentle, elderly schoolteacher who gave us the same story which many physicians are hearing daily everywhere. She had noticed blood in her stool for several months and having seen the blurb in the local paper about the forthcoming visit from a "pile-doctor," she went to see him. He injected her "hemorrhoids," and two months later she visited an old friend who was a doctor's wife. The bleeding still continued. Fortunately, she told the friend the whole story and a carcinoma, involving the posterior wall of the rectum with slight fixation, was found and removed. The loss of two months' time, however, may make a great difference in the prognosis.

In another similar case, a rural letter carrier in a Central state noticed slight diarrhea of two months' duration. He saw the advertisement of a well-known quack and instead of going to a reputable hospital within a few miles of his home, he fell into the clutches of the charlatans. He was told that for $140.00 in advance a cure would be guaranteed. The diagnosis was "colitis." After submitting to "colonic lavages" every day for two weeks he left, five pounds lighter in weight and $140.00 lighter in pocket. We saw him nine weeks later and found an advanced carcinoma of the rectosigmoid, of which he died very shortly thereafter. A colostomy was done as a palliative measure.

It is true, of course, that the commonest cause of bleeding from the rectum is from hemorrhoids. In fact, in my experience, 20 per cent of all people examined proctosigmoidoscopically will be found to have hemorrhoids to a greater or less degree. However, as it has often been found that hemorrhoids may be present in addition to further pathology of much greater importance higher up, we have now established the definite rule never to treat hemorrhoids until the patient has been sigmoidoscoped. As a matter of fact, I have seen several cases of chronic ulcerative colitis which have been completely missed on account of the presence of hemorrhoids. Unfortunately, in some of these cases much damage is done in operating upon the piles because of the slowness with which repair takes place in the presence of chronic ulcerative colitis.

Fissures are frequently the cause of bleeding per rectum, but the diagnosis is fairly easy and definite since there is pain and bleeding at stool, as a rule, and of course one can see the fissure with careful and correct examination. Fistulae also bleed occasionally, but they are less important as a source of blood loss.

Polyps of the colon and rectum can be of great importance as a cause of bleeding per rectum. It is quite possible for a person to have one or more polyps which give no

symptoms whatever and which are found at autopsy. As a general rule, however, polyps will eventually cause bleeding, which may appear in the stool as fresh blood or which may be so slight and so mixed with feces as to make chemical tests necessary for its detection. Here again, it is extremely necessary to eliminate the last 25 cc. or so of large bowel and rectum insofar as polyps are concerned before performing any treatment of hemorrhoids. We have seen a considerable number of cases of patients who have had bleeding from sigmoid polyps and who have been operated upon for hemorrhoids under the mistaken impression that the blood was coming from the rectal veins. Now and then we see a patient who has marked hemorrhage from a polyp high in the colon, although as a rule bleeding from these isolated neoplasms is slight. It has been thoroughly shown[1] that polyps are often precursors of cancer, and for that reason it is most important that they be discovered, if they are the source of bleeding, and properly treated.[2] Even in children one must think of polyps of the colon when there is a complaint of intermittent bleeding per rectum. I have seen five cases in children between the ages of 7 and 3, all of whom successfully underwent transcolonic excision of their tumors. It is interesting to note, in passing, that in two of these children of the same age the polyps were of the same size. However, one patient had been known to have intermittent bleeding per rectum for four years, whereas the other had complained of bleeding for only ten days.

Bleeding per rectum is very frequently found with diarrhea, whether the diarrhea be due to an organism or not. Naturally one should always examine the stool for amebae of amebic dysentery, and for parasities of various types such as ascaris lumbricoidales, ova of parasites, oxyuris vermicularis, etc. In these cases one usually finds a marked degree of anemia, and there is usually a history of travel in southern climates or of eating improperly kept food.

Congenital polyposis deserves a paragraph by itself, as it is without doubt one of the most serious diseases which may be responsible for bleeding per rectum. Although this condition is rare, fortunately it has been the subject of considerable medical literature in the past few years. As a rule symptoms of this disease begin before or during puberty and bleeding is always the most serious sign. Coupled with the terrible diarrhea which is characteristic of this disease, it makes a most difficult and distressing syndrome to treat. Usually polyps will be found upon proctosigmoidoscopy throughout the entire rectum and sigmoid, and contrast barium enemas will show in many cases that the entire colon is involved in every square centimeter. In these cases surgery offers the only hope of cure, and this means complete ablation of the colon or at least the larger part of it.

Changed blood or occult blood, which is frequently found in the examination of the stool, may come from the stomach, esophagus, nasopharynx, duodenum or anywhere else in the gastrointestinal tract.

From the point of view of the proctologist, sigmoidoscopy offers much in the diagnosis of bleeding per rectum. Coupled with roentgenographic studies of the colon, it may be safely said that these two methods of examination will disclose 98 per cent of all colon-rectal pathology. Some may say that an attempt is being made to proctoscope too many patients without sufficient indication for so doing. It may be true that only 1 per cent or so of all hemorroidectomies is done in the presence of a carcinoma higher up, but as far as the patient with cancer is concerned that 1 per cent is 100 per cent. In our efforts to control cancer, especially cancer of the rectum and colon, we must not fail to remember that we have two everready aids at our immediate command, one the finger and the other the proctosigmoidoscope. And if to these we add roentgenographic examination, careful history taking and assiduous physical examination, important pathology which may underlie some obvious but minor disease will not be overlooked.

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Case Reports

HOUR-GLASS TUMORS OF THE CERVICAL SPINE*

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THE expression, "hour-glass tumor," is a descriptive term which refers to a morphological characteristic of certain spinal cord tumors. Because of the narrowed portion connecting two enlargements at both ends, the tumor assumes an hour-glass or dumb-bell appearance.

The usual arrangement is for the intraspinal portion to lie either extradurally, which is more common, or intradurally; and for the extraspinal part to lie in the paravertebral region with the narrowed connecting portion extending through the intervertebral foramen. The tumor occasionally passes from the spinal canal by way of the interlaminal space rather than by the intervertebral foramen. This is rare, however. It may lie wholly within the spinal canal, in which case one enlargement lies within the dura and the other outside, with the constriction at the point where the spinal nerve passes through the dura.

It is realized that the present meager literature is not an index to the incidence of the lesion. It is believed that altogether too little consideration has been given this tumor as a clinical entity, inasmuch as it has been more frequently classified and grouped along with spinal tumors according to histological type. It seems desirable to emphasize the clinical aspects because it is highly important that its nature be recognized before operation, so that special technical problems may be worked out beforehand. Craig[1] emphasized this point and reported three cases in which one or more reoperations were performed because of the recurrence of the intraspinal tumor by extension from the unrecognized paravertebral portion. Sometimes, particularly in those lesions in the thoracic area, it is highly desirable to have the co-operation of a thoracic surgeon at operation, as in the case reported by Craig and Harrington.[2] At other times, if the tumor is recognized, it may be advantageous to plan the operation in two stages. Because of these special technical problems the patient can be better served by considering this tumor separately from other spinal cord tumors.

This report is made in order to further emphasize this lesion as a clinical entity, and also to mention a case in which there was a very unusual arrangement as well as extensive development of three cervical tumors.

LITERATURE

The literature is surprisingly meager. A careful search revealed but eight direct references to the lesion. Heuer[3] covered the subject in a very comprehensive manner, while Naffsiger[4] laid stress upon some pertinent points concerning the surgical aspects and added fifteen cases to the literature. Special mention of this tumor in a consideration of other spinal cord tumors has been made, among others[5–11] by Craig, Dandy[12] and Elsburg.[13]

Heuer, in 1929, gathered from his own files and the literature, sixty-four cases. By 1933, nineteen more cases were added,

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making eighty-two in all. Since then Craig has reported four cases, Bunts[14] two and Bozzi[15] one.

CLINICAL CHARACTERISTICS

Hour-glass tumors may arise from anywhere along the spine, but most commonly from the thoracic area. Of the cases reported, 27 per cent occurred in the cervical area, 59 per cent in the dorsal, and 12 per cent in the lumbosacral area.

It is with the cervical group that we are especially concerned. I am aware of but twenty-two cases reported or mentioned. It was noted that in only a few cases was a diagnosis made before operation, and these by individuals particularly interested in the lesion. A goodly number were not recognized after the removal of the single spinal or paravertebral portion at operation.

The great majority of these tumors are circumscribed and benign, since they usually arise from the canal membranes, the nerve roots and infrequently the ganglia. There were two reported sarcomas. Of all the patients operated upon, only one tumor could not be removed totally from the canal.

The size of the intraspinal portion of the tumor may vary within moderate limits, but the majority are small or about the size of a hazelnut. They compress, but do not otherwise involve the cord, and lie either within or without the dura, more frequently the latter. The paravertebral portion may vary in size from that of a plumb to an orange and present itself either in the anterior or posterior triangle of the neck. About 80 per cent are visible or palpable. In 16 per cent of the cases reported a paravertebral lesion was not recognized before the operation or autopsy.

The manner in which the growth extends itself has not been definitely decided. Opinions have been expressed that extension is from within out, or from without inward; also that with an origin in the intervertebral foramen the tumor extends both inward and outward. Coenen[16] and Heuer seem to think that a more plausible explanation is that the tumor takes a passive and not an active rôle in determination of its shape; that it is present before the development of the spine, and that the spine impinges upon and constricts it, thus producing the hour-glass contour.

SYMPTOMATOLOGY

In cases of hour-glass tumors of the cervical spine, the principal symptoms are those due to compression of the spinal cord and these in no way differ from the clinical picture produced by other spinal cord tumors in this area, except roentgenographically. An enlargement of the intervertebral foramen, through which the tumor protrudes is frequently noticed and should always be looked for. (Fig. 1.) If present, this enables one to suspect the true nature of the lesion even when the paravertebral portion of the tumor cannot be seen or palpated in the anterior or posterior triangle of the neck.

Root pain, early, before cord signs develop, followed later by numbness, weakness, and atrophy in one of the upper extremities, occurs with tumors of the lower cervical region. The above signs and symptoms may be greatly extended should the paravertebral lesion be large enough to compress the cords of the brachial plexus.

DIAGNOSIS

Recognition of this lesion is not difficult if the lesion is kept in mind when dealing with spinal cord tumors or paravertebral tumors. Before 1930, diagnosis before operation or autopsy was rare, and the dual nature of the lesion was usually discovered after an attack upon the single intraspinal or extraspinal portion. Perhaps Heuer's and Naffsiger's papers played some part as a reminder, for since 1933, recognition has been more common and not the exception as it was before 1929. Enlargement of the intervertebral foramen is pathognomonic of this lesion.

CASE REPORT

J. C. W., female, aged forty-three, was admitted to the hospital June 27, 1937, complaining of a tumor in the left supraclavicular region, of pain and weakness in the left upper extremity and paralysis of both lower extremities.

In August, 1935, (approximately two years before), a tumor had been removed from the left supraclavicular region. Eight months later, in April, 1936, a tumor was again removed from the same place. Although within the next year the tumor had again reoccurred and was palpable, she had not concerned herself with its presence until six weeks ago when she first noticed weakness in the left lower extremity. A little later the right lower extrenity was also involved. Twelve days before admission to the hospital, the patient had developed almost a complete paralysis of both lower extremities along with urinary retention.

Examination showed a fairly well developed, undernourished, female, with a scar in the left supraclavicular area. There were numerous cafe-au-lait spots over the body and innumerable cutaneous forms of neurofibromas. In addition, there was a profuse discharge from the right nostril caused by a sinus infection. Both upper extremities were weak, the left more than the right, with definite atrophy of the muscles of the hand and forearm. There was a paraplegia with an accompanying sensory loss. An indefinite sensory line was found over the lower abdomen. The hypaesthesia gradually blended into an anesthesia a few inches above the knees. Slight motor function remained in the thigh muscles. There was a clonus and a loss of sphincteric control. A lumbar puncture revealed an absolute block. Total protein was 1,100 mg. per 100 cc. and 171 mg. in the cisternal fluid. The Wassermann test was negative.

X-rays of the cervical spine showed the seventh cervical intervertebral foramen on the left side to be approximately twice as large as the sixth. There was a thinning of the superior articular facet of the seventh cervical vertebra. The pedicle of the sixth cervical was narrowed. (Fig. 1.)

There were 4,020,000 red cells, 7,500 white cells, polys 90 per cent. The urine was essentially negative.

On July 6, 1937, under local anesthesia, a cervical laminectomy was performed. An intradural tumor was found, producing considerable pressure upon the cord. It was about the size of a pecan and was attached to the eighth cervical nerve on the left side. When the tumor had been freed from the cord and dislodged, it was found that the lateral portion extended on through the intervertebral foramen. The dissection was continued as far lateral as possible and the pedicle sectioned on the outside of the canal. There was a dural attachment. At the time it was difficult to say whether or not this tumor actually arose from the nerve or from the dura. The dural attachment was thoroughly coagulated with the Bovie unit.

Convalescence was uneventful. Two months later, the patient was walking with the aid of walker, and was able to void voluntarily. She gradually regained strength and was able to carry on normally except for a gradually progressive pain in the left upper extremity. A similar pain had been relieved in 1936 by removal of the supraclavicular tumor but returned when the tumor reoccurred. She was sent home for further recuperation.

On February 13, 1938, she returned for the removal of the supraclavicular tumor. She had gained considerable weight and was able to get around in good fashion, and aside from the pain in the left upper extremity, felt well. There was increased atrophy and paresis of the left upper extremity. The left hand was held in the right most of the time. The tumor had become more prominent in the left supraclavicular space.

Under local anesthesia, excising the old scar made in 1936, the supraclavicular tumor was removed. The tumor was followed back to the external margin of the intervertebral foramen, which was large enough to admit the index finger. It was attached to and had distorted the regular positions of the trunks of the brachial plexus. It was freed without injury to any of the nerve elements.

Convalescence was not remarkable. The patient left the hospital nine days after operation. At this time, it was thought that all of the tumor had been removed, at least, none was seen in the supraclavicular area or about the intervertebral foramen.

On March 26, 1939, a little over a year later, the patient returned to the hospital stating that although she was relieved of pain after the last tumor had been removed, that the

pain recurred about six months ago but was a little different in that it radiated down into the hand and the index and middle fingers.

area high up and extending well down into the axilla and onto the arm. The clavicle was bisected and reflected to both sides. The entire

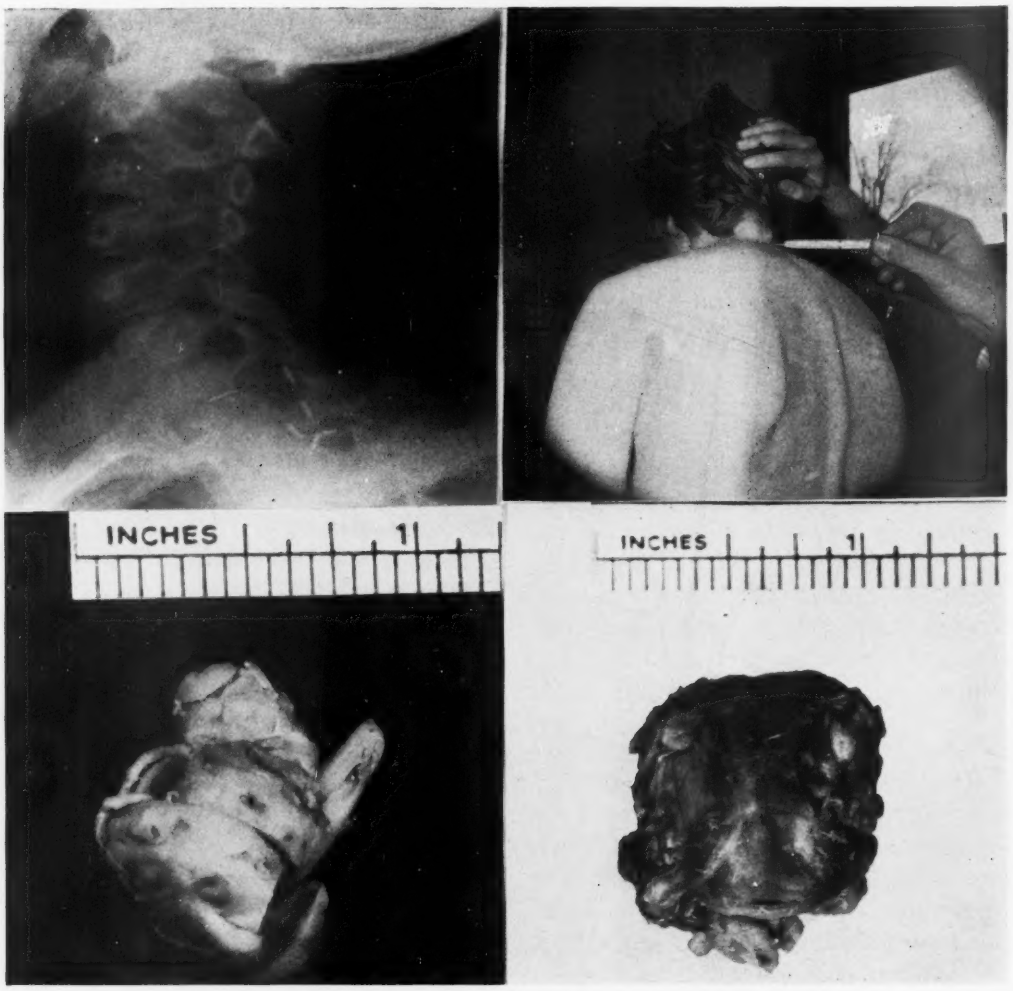

Fig. 1. Upper left; shows enlarged intervertebral foramen; pathognomonic of hour-glass tumors of the spine.

Fig. 2. Upper right: shows cafe-au-lait spots of skin, superficial neurofibromas and operation incision for laminectomy for removal of tumor.

Fig. 3. Lower left: intraspinal portion of hour-glass tumor.

Fig. 4. Lower right: paravertebral portion of hour-glass tumor.

There was about 50 per cent atrophy of the palm and the thenar eminence. Her general condition was good and she had gained about twenty pounds. The extremity had improved in function at first, but again lately there had been a definite decrease in motor function. There was a tumor, palpable in the axilla, which appeared to extend well up under the clavicle into the supraclavicular space. It was firm, encapsulated and slightly mobile.

The laboratory findings were essentially negative.

On March 27, 1939, under local anesthesia, an incision was made in the supraclavicular

brachial plexus was found expanded into a fusiform tumorous enlargement, approximately nine inches long. The tumor was composed of fusiform enlargements of the various portions of the brachial plexus with the normal nerve trunks gradually expanding and becoming a part of the main tumor. There were many ramifications extending from the main tumor body. Some were small and some as large as your thumb, while the tumor itself was larger than one's wrist. The patient was informed of the nature of the tumor and she agreed that she would rather have it removed with the possibility of securing relief from the pain,

particularly inasmuch as the arm had been practically useless to her in the last few months. Accordingly, the various branches of the brachial plexus leading into the tumor were exposed and sectioned. Finally the tumor was dissected free from the subclavian artery and vein, and removed intact.

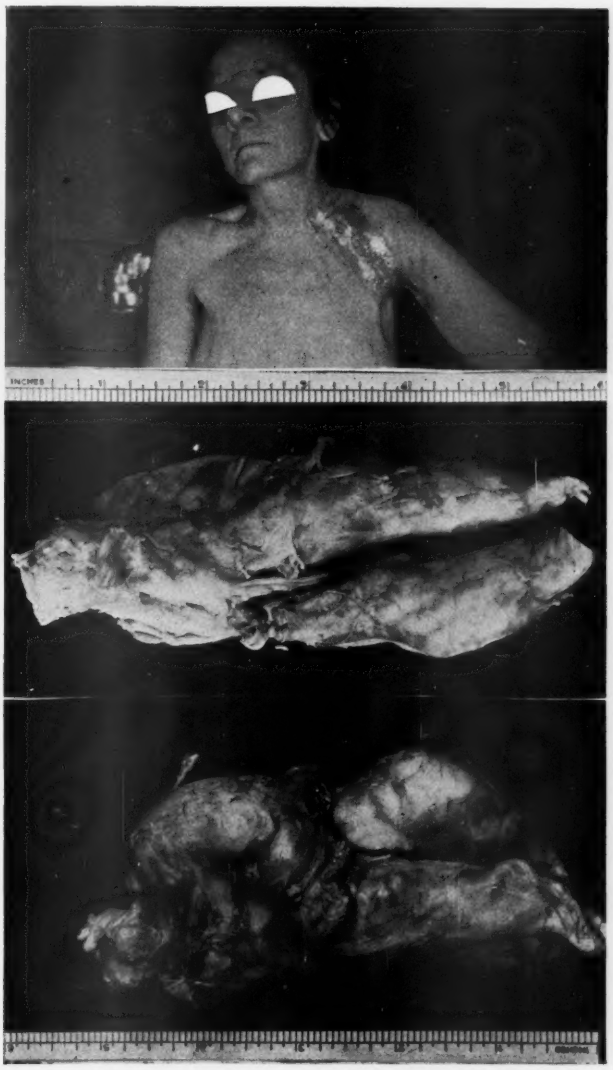

Fig. 5. Top: showing patient and incision for removal of tumor shown in Figures 6 and 7.
Fig. 6. Center: tumorous enlargement of the cords of the brachial plexus.
Fig. 7. Bottom: different view of Figure 6.

This left the arm without any innervation, yet the blood supply was good and the wound healed well. Convalescence was normal. The patient was able to leave the hospital in twelve days free of all pain. (Figs. 2, 3, 4, 5, 6 and 7.)

Pathologic Report. "The intraspinal tumor was composed of interlacing bundles of spindle cells running in various directions. They were quite large in size with oval or elongated nuclei. Some huge nuclear forms were present, and many of the nuclei were packed with chromatin granules. There was an abundance of giant cells, and most of them were multinucleated. Occasionally plump polyhedral cells were seen. Mitotic figures were present. The tumor appeared quite fibrous in parts.

"The second tumor was found at operation to have been connected with the first, so that the original tumor was of the dumb-bell type. Microscopically it had essentially the same appearance as the first specimen. One of the pieces, however, was much more fibrous. It was composed almost entirely of spindle cells with

very elongated narrow nuclei, tending to run in parallel rows and apparently producing abundant fibrils. In one area ganglion cells were included. The other piece was more densely cellular. The nuclei were packed closely together and the same huge nuclear forms were present as in the first specimen. Many contained very large nucleoli. Giant cells and mitotic figures were again noted.

"The tumor of the brachial plexus was also of similar histological appearance. It contained a great abundance of the giant multinucleated cells. There was marked variation in the size of the nuclei, from small, irregular forms, to very large, round or elongated ones. Mitotic figures were present in this specimen also.

"*Diagnosis.* Neurofibromata of von Recklinghausen type. In view of the mitotic figures present in every specimen, the impression was that the tumors were undergoing a malignant transformation."

COMMENT

Obviously this patient suffered from von Recklinghausen's disease. There were many large cafe-au-lait spots, innumerable small superficial neurofibromas and the deep lesions involving the brachial plexus which had undergone malignant changes. The latter had reoccurred, were operated upon four times and eventually involved the entire brachial plexus. The first two operations at which the paravertebral tumor was removed, the true nature of the lesion was not recognized. It was not until a paraplegia developed that an hour-glass tumor was suspected and verified roentgenographically by the enlarged intervertebral foramen.

When dealing with paravertebral tumors or spinal cord tumors, separately or together, one should bear in mind the possibility of an hour-glass tumor and include in the study of the case a lateral roentgenogram of the spine for visualization of the intervertebral foramen.

SUMMARY

1. The clinical characteristics of hour-glass tumors of the spine have been presented.

2. Clinically and from an operative standpoint they should be considered a clinical entity.

3. A case of hour-glass tumor of the cervical spine, associated with huge brachial plexus tumor, was reported.

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PRIMARY CARCINOMA OF THE AMPULLA OF VATER*

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PRIMARY carcinoma of the ampulla of Vater is a rare pathologic condition seldom diagnosed before surgical intervention or autopsy. Due to its strategic location, biliary and possibly pancreatic obstructions occur while the tumor is relatively small and death often occurs due to interference with the vital function of the liver and possibly the pancreas before surgical intervention is accomplished. The case here reported was verified at autopsy.

CASE REPORT

A. H., a woman, aged sixty-four, was admitted to Mercy Hospital on September 2, 1937, with a history of indigestion and pain in the right upper quadrant for two months. The onset was insidious, beginning with pain in the right flank followed by the formation of a mass which gradually increased in size. Jaundice was noted by her friends. Because of the indigestion, her diet had consisted mostly of milk. Her stools had been watery and clay colored, and loss of weight was marked.

Physical examination revealed a poorly nourished, moderately jaundiced senile woman in no apparent distress. There was a slight elevation of temperature. The abdomen was distended and tympanitic. The liver edge was palpable four fingers below the right and left costal margins. The gallbladder was palpable as an extremely large, movable mass, filled with fluid and extending into the right lower quadrant; it was mildly tender and moved with respiration.

The urine contained bile in the majority of specimens, and most of the stool specimens showed blood. The icteric index was 18.6. Blood examination showed 3,400,000 erythrocytes, 9,700 leukocytes, and 71.4 per cent hemoglobin. Duodenal aspiration revealed no bile, and no free hydrochloric acid was found in the gastric analysis. Bleeding and coagulation times were three minutes each. Roentgenographic examination showed an enlarged and distended gallbladder, poorly visualized, with cholelithiasis. Barium enema revealed the right colon above the mass.

A preoperative diagnosis was made of obstructive jaundice, probably due to carcinoma of the head of the pancreas or stomach, with cholelithiasis.

Following a blood transfusion, the patient was operated upon on September 16, 1937. A high right rectus incision was made. The gallbladder was found to be greatly enlarged; it was filled with 400 cc. of thin, turbid, pale brown fluid and contained sixty stones varying in diameter from 3 mm. to 3 cm. The wall of the gallbladder was thickened. Several indurated areas were found in the wall which on microscopic examination proved to be moderately rapid growing adenocarcinoma. An infected hydrops (early empyema) was noted. The cystic duct was obstructed and the common duct was indurated and dilated to approximately 2.5 cm. in diameter. A large indurated mass was felt in the ampullary portion of the duodenum, extending posteriorly and upward and involving the head of the pancreas, common bile duct and adjacent glands. The stomach was apparently normal and no metastases were noticed in the liver. Palliative surgery was decided upon; about half the gallbladder was removed and a cholecystostomy performed.

The patient was discharged from the hospital on October 12, the twenty-sixth postoperative day. The jaundice had cleared and she had no pain. Weight loss and emaciation were progressive. A moderate amount of purulent, foul smelling drainage persisted until her death on February 16, 1938, four months after operation.

Autopsy by Dr. John Sheehan revealed a deep ulcer in the duodenum, 2.5 cm. in diameter, replacing the ampulla of Vater and tissues adjacent to it. The wall and base of this ulcer were composed of tumor, found microscopically

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to be a poorly differentiated adenocarcinoma. The common hepatic duct ended abruptly in the cavity produced by ulceration. The tumor in the wall of the ulcer extended outward from the ulcer, replacing the neck of the gallbladder and invading part of the head of the pancreas. It permeated the tissue of the lesser omentum, passing posteriorly to the hepatic ducts and portal vein, and invaded the liver. Lymphatic permeation of the wall of the gallbladder by tumor and diffuse replacement of much of its mucosa by tumor were noted, but there was no single mass of any appreciable size in the gallbladder and no marked involvement of any portion of its wall. (A hydrops of the gallbladder had been noted at operation.) The only metastasis found was in the upper aortic nodes. The pancreas was normal except for involvement of the head immediately adjacent to the tumor. (Figs. 1 and 2.)

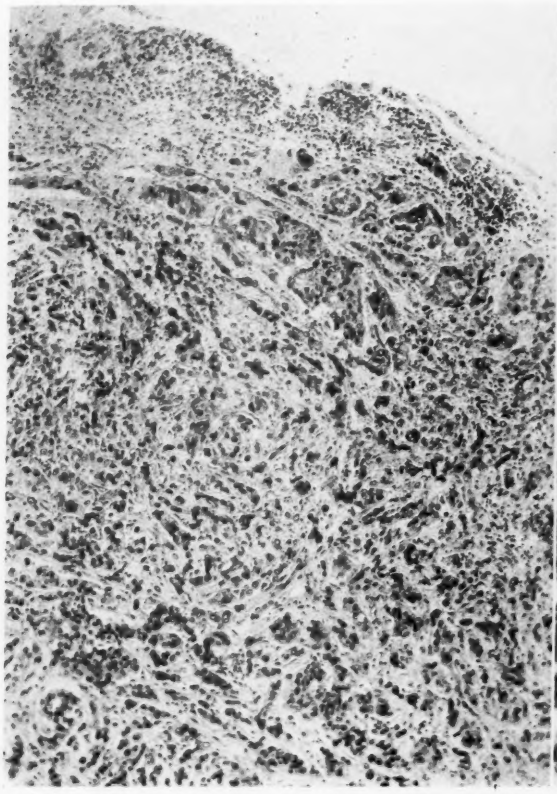

Fig. 1. Photomicrograph showing a section of the wall of the ulcer in the duodenum. Upper free edge of specimen represents portion of wall of hepatic duct; epithelium absent. Wall and tissues around duct are heavily infiltrated by tumor. × 100.

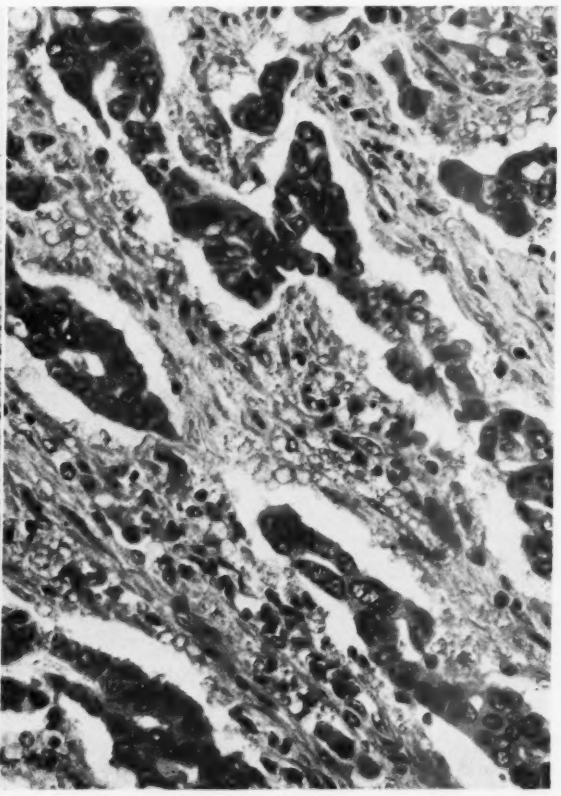

Fig. 2. Photomicrograph of the tumor showing a fairly well developed adenocarcinomatous structure. × 500.

While origin of the tumor in the head of the pancreas or in the neck of the gallbladder could not be ruled out absolutely, the large ulcer in the duodenum, a pancreas negative except for invasion of the head immediately adjacent to the ulcer, and a relatively slightly involved gallbladder pointed to an origin in the ampulla of Vater as the most logical possibility.

The only other significant findings at autopsy were a suppurative cholangitis with multiple fairly large abscesses in the right lobe of the liver, a moderate splenomegaly, ascites and a left hydrothorax. The portal vein and the right and left hepatic bile ducts were pushed forward and compressed by the tumor in the lesser omentum.

DISCUSSION

Primary carcinoma at the ampulla of Vater, according to Mayo-Robson[1] was probably first described by McNeal in 1835 (North American Archives, Baltimore) and was later drawn attention to by Stokes in 1846 (Dublin Quarterly Journal of Medical Science). Rolleston[2] states that Busson, in 1890, collected eleven cases and Hanot and

Georges, in 1896, contributed to the subject. In 1898, Halsted[3] successfully resected an ampullary carcinoma and since that date the subject has attracted more widespread attention. In the succeeding years Schüller,[4] Outerbridge,[5] Cohen and Colp,[6] Hunt and Budd,[7] Whipple, Parsons and Mullens,[8] and others contributed to the literature. Cooper[9] in 1937 reviewed the subject and added to the literature fourteen cases observed in the New York Hospital between the years 1915 and 1935. Hoffman and Pack[10] in the same year in a review of 228 reported cases of carcinoma of the small bowel found 104, or 45.6 per cent in the duodenum, of which 61.9 per cent were at the ampulla of Vater.

The average age incidence in Rolleston's[2] and Outerbridge's[5] combined series was 54.9 years; the youngest reported case was in a patient of thirty years (Mayo-Robson),[1] while a patient of eighty-one years is mentioned in Rolleston's series.

Males are affected more frequently than females by a ratio of 2:1.

Cholelithiasis apparently is not a strong etiologic factor in this type of carcinoma. In Cooper's series,[9] 22 per cent gave a history of having suffered from gallstones. Duodenal peptic ulcer has been cited as a possible cause. This is questionable since duodenal ulcers and carcinoma of the ampulla of Vater rarely or never exist in the same patient. Embryonal pancreatic rests are mentioned in the literature as a possible etiologic factor. These aberrant rests do occasionally occur in and about the second portion of the duodenum but, according to Branch and Gross,[11] seldom undergo carcinomatous changes.

In many cases the histogenesis of the tumor cannot be determined because the entire ampullary region may be involved. The microscopic sites of origin may be from any of the following tissues: (1) epithelial lining of the ampulla of Vater; (2) duodenal epithelium of the peri-ampullary region or of the duodenal papilla; (3) epithelium of the terminal common bile duct or of the terminal pancreatic duct; (4) Brunner's glands in the submucosa of the papilla, or (5) aberrant pancreatic tissue.

Two distinctive types of tumors are recognized, namely, the papillary and the ulcerating, with variations between the two extremes. The tumor may vary from a few millimeters to more than 3 cm. in diameter. The patient becomes jaundiced if the common bile duct is obstructed. In the ulcerating type this jaundice may be characterized by remissions and exacerbations due to the rapid growth of the tumor followed by ulceration and release of the obstruction. Columnar cell adenocarcinoma with cells arranged in alveoli or pseudo-alveoli is the most common type. Some of the rare varieties reported are colloid carcinoma (Walters),[12] squamous cell carcinoma (Cohen and Colp),[6] and scirrhus carcinoma (Arnsperger, quoted by Cooper).[9]

Malignant tumors of this region other than carcinoma are exceedingly rare, but the following types have been reported: Spindle cell sarcoma (Moll),[13] melanoma (Jones),[14] melanoma (probably carcinomatous) (Duval),[15] and lymphosarcoma found at necropsy at the Cook County Hospital by the late Dr. Jaffé.

A few benign ampullary tumors have been reported. In 1933, Christopher[16] in reviewing the literature found forty-one cases and added a benign adenoma. In 1934, Landivar[17] added a papilloma.

Metastasis occurs in from 20 to 36 per cent of the cases, according to various investigators; however, many times death supervenes rapidly before metastasis has had time to occur. Primary carcinoma of the ampulla of Vater metastasizes in the following manner: (1) local extension to the pancreatic lymph nodes, to the second portion of the duodenum and to the pancreas through the intimate relationship of the lymphatics; (2) lymphatic extension to the periportal lymph nodes at the hilus of the liver and the pre-aortic nodes, and (3) visceral metastasis via the lymphatics to the liver most frequently; unusual metas-

tases are to the lungs, pleura, peritoneum and omentum.

Due to the obstruction of the ducts and the infections which may occur, pathologic changes are present in the liver, pancreas, gallbladder and biliary ducts. The liver is smooth and enlarged. Multiple hepatic abscesses and a suppurative cholangitis are common in the ulcerating ampullary tumors in which the opportunity for infection is great. The head of the pancreas is hard and nodular. The common and hepatic ducts are dilated and sometimes the cystic duct will be dilated also. The gallbladder is usually greatly distended and palpable but not tender.

In most patients a past history of biliary colic may be obtained. There is an onset of epigastric or right upper quadrant pain, either cramp-like or burning; an increasing obstructive jaundice follows which may be constant or intermittent in character. If the jaundice persists, chills and fever of the intermittent Charcot type may occur. General pruritus, acholic stools and dark urine are noticed. Loss of weight is rapid, and if the carcinoma is of the ulcerating type blood in the stools is quite characteristic together with a marked anemia. Diarrhea may be present. Anorexia is usually a prominent symptom. Vomiting is not common and when it does occur no bile is found in the emesis; continued vomiting indicates duodenal obstruction. Ascites may occur but is rare.

Obstructive jaundice, diarrhea and intestinal bleeding are considered by some authorities to be diagnostic features. Courvoisier's law is also an aid in diagnosis. Roentgenography may be of value by the following findings: (1) obstruction with dilatation of the first part of the duodenum and stomach; (2) filling defect of the duodenum; (3) duodenal flattening from behind, and (4) irritability of the second part of the duodenum.

An attempt should be made to differentiate carcinoma of the ampulla of Vater from other tumors which cause a palpable gallbladder, the most common being carcinoma of the head of the pancreas and carcinoma of the common duct. This is difficult to establish but persistent occult blood in the stool, anemia and roentgenographic changes in the second portion of the duodenum are helpful.

Primary carcinomas of the ampulla of Vater are operable early and are treated either by palliative or radical operation. Palliative operative procedures, cholecystostomy or cholecystogastrostomy, are performed when the more radical procedures are contraindicated. Transduodenal resection with reimplantation of the duct has been the procedure most commonly employed, when the tumor was small, papillary, free of ulceration and without infiltration. The surgical mortality, however, is high and recurrence may ensue.

Since the expectancy of life is very short in malignancies of this region, the operation of choice should be, if possible, the two-stage wide resection of the duodenum as described by Whipple and his associates,[8] in both the papillary and ulcerating types of lesion, if any hope of a cure is to be expected.

SUMMARY

A case of primary carcinoma of the ampulla of Vater is reported, together with a review of the literature, an outline of the outstanding symptoms, points in differential diagnosis and the methods of treatment.

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In dealing with cardiacs, one should remember that over dehydration is just as bad for cardiacs as for normals, but unlike normals, cardiacs are in grave danger from too much fluid.
From—"The Heart in Pregnancy and the Childbearing Age"—by Burton E. Hamilton and K. Jefferson Thomson (Little, Brown and Co.).

SPONTANEOUS RUPTURE OF UTERUS IN FOURTH MONTH OF PREGNANCY*

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RUPTURE of the antepartum uterus is one of the most infrequent accidents of pregnancy. So unusual is this condition that some textbooks of obstetrics fail to mention it, others merely mention the possibility while discussing rupture of the parturient organ. DeLee,[1] Curtis[2] and Beck[3] uniformly agree that it is very unusual if one excludes perforation of the uterus by criminal abortionists. Baisch[4] in 1903 collected seventy-eight cases of rupture of the uterus during pregnancy and added a case of his own in which the accident occurred during the thirty-sixth week. Of the seventy-nine cases only thirty-one occurred during the first five months of pregnancy. In 1904 DeLee[5] reviewed the literature and presented a case in which indirect trauma caused the rupture of a uterus in the eighth month. Kane[6] in 1923 reported a case of spontaneous rupture of the body of the uterus in the sixth month of pregnancy.

Riddell[7] has classified these cases into three types: (1) cases in which no gross anatomic defect is present, in which the predisposing cause is a diseased, degenerated or previously injured uterus, with indirect violence frequently the exciting cause; (2) cases in which there are gross lesions, such as interstitial pregnancy, pregnancy in a rudimentary horn of a bicornuate uterus, new growths, hydatidiform mole, or rupture of the scar of a previous cesarean section (the latter, because of the increasing popularity of cesareans, is responsible for most); (3) traumatic ruptures due to wounds by such instruments as sounds, curettes, bullets, or by crushing or other forms of violence.

A digest of the more recent literature affords us examples, though relatively few in number, of the more frequent predisposing etiologic factors. Snidow[8] reported the spontaneous rupture of a uterus in the sixth month of pregnancy, in which there had previously existed a severe puerperal endometritis. Gordon[9] operated on a ruptured uterus in which pregnancy had occured in the closed rudimentary horn of a bicornuate uterus. Yule[10] had a patient in whom spontaneous rupture had occurred during the fifth month in a uterus which was the seat of fibroids. Fletcher[11] reported a patient who had a spontaneous rupture of the uterus in the eighth month one and a half years after a curettage for subinvolution following a miscarriage. Lankowitz's[12] patient likewise had a spontaneous rupture during the fifth month following a previous abortion and curettage. Ivanow,[13] Baird[14] and Swift[15] all report spontaneous rupture of pregnant uteri which had previously been subjected to cesarean sections. Ridell and Scholefielf[16] sutured a 4 inch rent in the right cornu of a uterus thirty-two weeks pregnant in which spontaneous rupture had occurred without violence and without any antecedent history.

To this group of unusual cases we add another. Spontaneous rupture occurred in the right cornu of a three and a half months pregnant uterus sixteen months after a salpingectomy had been done on the same side. In addition a recent corpus luteum was found in the ovary on the same side.

CASE REPORT

Mrs. F. L., 25 years old, white, never before pregnant, was operated on at the Jewish

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Hospital of Brooklyn on July 17, 1938. A right salpingectomy was performed. The pathologic report showed papillary adenocystoma of the

Fig. 1. Uterus with rupture at right cornu; fetus extruded; placenta in situ.

right tube. Her history previous to this operation was essentially negative. Menses started at 13, occurred regularly every twenty-eight days and lasted four days There had been no previous illnesses.

Her last menstrual period began on August 13, 1939. On October 5 she had dull aching pain in the right lower quadrant. Pregnancy was diagnosed by one of us (S. B. S.). The patient felt well until November 11, when at 8 P.M., during bowel evacuation, she felt weak and faint, but had no pain. After trying to help the patient with home remedies, the family sought medical aid. Examination at 10 P.M. (by M. J. R.) revealed a marked pallor with blanched mucous membranes. The patient was cold and clammy. Temperature was 97°F., pulse 60, blood pressure 60/40. The lower abdomen was moderately distended and presented a midline lower abdominal scar. Tenderness over the lower abdomen was definitely more marked on the right side. Upon vaginal examination, the cervix was soft and slight manipulation caused such pain that further examination was not done. Because of the catastrophic picture we believed that we were dealing with intra-abdominal hemorrhage and diagnosed ruptured cornual pregnancy.

Morphine sulfate gr. $\frac{1}{4}$ and atropine sulfate, gr. $\frac{1}{150}$ were given, external heat was applied and the patient was placed in the Trendelenburg position while awaiting the arrival of the ambulance.

On her admission to the hospital at 11.45 P.M., temperature was 97.8, pulse was 104 and of poor quality, and blood pressure was unobtainable. The patient was immediately typed for transfusion and sent to the operating room. Under ether anesthesia the old operative scar was excised and the abdomen opened. The peritoneal cavity was filled with blood, estimated at 2,000 c.c. The uterus was about the size of a four months' pregnancy with a rupture in the right cornual end, the fetus partly protruding through this rent into the peritoneal cavity. The right tube was missing, having been removed at the previous operation. The

right ovary was the seat of a corpus luteum. The left tube and ovary were normal. The upper half of the uterus at the site of the rupture was markedly thinned out and the rupture measured about 6 cm. A direct blood transfusion of 600 c.c. was given during the course of the operation.

Because of the marked thinning of the upper portion of the uterus, it was impossible to preserve much uterine tissue, and a high supracervical hysterectomy was performed, leaving as much of the lower uterine segment as possible. It is questionable whether enough uterine tissue was preserved to maintain menstruation. Both ovaries and the left tube were left in situ. Raw surfaces were peritonealized and the large blood clots were removed. The wound was closed in layers without drainage. After completion of the direct transfusion a venoclysis of 5 per cent glucose in saline was administered.

At the termination of the operation the patient was still in shock, pulse and blood pressure were unobtainable She was kept on the operating table in Trendelenburg position, external heat was applied, caffeine was administered and oxygen was supplied by inhalation. After an hour the pulse and blood pressure returned and at 2.30 A.M. a transfusion of citrated blood by the drip method was started, 600 c.c. of blood being administered. At 5.30 A.M. the pulse was 92 and the blood pressure was 100 systolic, 42 diastolic. At 7 A.M. the patient was taken to her room.

Thereafter her postoperative course was uneventful and her recovery prompt. Hemoglobin rose from 47 per cent postoperatively to 70 per cent before her discharge and the red blood corpuscles rose from 3,000,000 to 3,900,000. The wound healed by primary union, the sutures were removed on the seventh day and the patient was discharged twelve days after the operation.

Pathologic Report (Dr. David M. Grayzel). The gravid uterus measured 9.5 by 9 by 4 cm. At the fundus there was an irregular opening 6 by 3.5 cm., with ragged edges, which communicated with the uterine cavity. Protruding from this opening was a portion of spongy tissue pink and gray in color, and several blood clots measuring 7 by 5 cm. Similar tissue protruded from the internal os. The uterine canal was filled with spongy pink, gray and red masses. The myometrium measured 2.5 cm. in thickness at its thickest part and was pink and trabeculated. There was a male fetus 14 cm. in length.

In a microscopic preparation from the placenta, well formed chorionic villi were seen lined by Langhans and syncytial cells. The connective tissue cores were loose and contained markedly engorged capillaries. Syncytial giant cells were numerous, and attached to some of them were sheets of decidual cells. The endometrium was broad and its surface partly covered by cylindrical cells. Endometrial glands were numerous and large, corkscrew in appearance and widely distended. The lining cells were tall and columnar with abundant cytoplasm and vesicular nuclei. The lumina contained amorphous pink and lavendar-staining material. The stroma was loose and in places contained large decidual cells. The muscular coat was broad and the muscle fibers large and broad. The vessels everywhere were widely distended.

Other preparations showed extensive areas of extravasated blood in which poorly preserved chorionic villi and numerous syncytial giant cells were scattered. The remainder of the wall consisted of bundles of large smooth muscle cells separated by loose connective tissue in which are seen distended blood vessels.

SUMMARY

A case is presented of spontaneous rupture of the uterus in the fourth month of pregnancy. This rupture took place in the region of the right cornu at the site of a salpingectomy performed sixteen months previous. The corpus luteum was seen in the right ovary. It is interesting to observe that in this case pregnancy occurred by migration of the ovum from the right ovary to the left tube.

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We can conclude that there is no substantial evidence that pregnancy tends to protect against, and only the faintest evidence of slight tendency to induce, recurrence of rheumatic fever in women with chronic rheumatic heart disease, or in women who have had rheumatic disease but have been left with apparently sound hearts.

From—"The Heart in Pregnancy and the Childbearing Age"—by Burton E. Hamilton and K. Jefferson Thomson (Little, Brown and Co.).

CONGENITAL CICATRIZING BANDS*

REPORT OF A CASE WITH ETIOLOGIC OBSERVATIONS

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CONGENITAL abnormalities have always been of interest to the casual observer and the anatomoembryologist. Many victims of such abnormalities have become wards of the state because of their disability. Others with minimal defects suffer little restriction of their activities.

The following is an account of a patient with congenital constricting bands of the fingers and toes with amputation and a deep constricting band of the right leg. This patient, in spite of the marked anatomical changes, has lived comfortably for about seventy years and his case lends support to the theory of "focal necrosis of limb bud tissue" occurring in early embryonic life.

CASE REPORT

C. S., a white man, aged seventy-two, came to the Dermatologic Out-Patient Department of the Hospital of the University of Pennsylvania in March, 1939, because of swelling of the right foot and a mild pruritic erythematous dermatitis on the posterior aspect of the right leg.

The family history contained no relevant congenital abnormalities or factors. At birth the patient was normal except for a constricting band around the distal portion of the right leg, annular creases around some of the fingers of both hands with a partial syndactylism of the fourth and fifth fingers of the right hand. His father removed with scissors remnants of the left index finger and fifth finger which were represented at birth by fibrous strands attached to the soft tissues proximally. At birth the right foot was the same size as the left, except for the structural differences to be described. His right foot has always been cold and somewhat cyanotic. At the age of twelve, his right foot was frost-bitten and because of possible gangrene, amputation was advised but was refused by his family. The patient had no further trouble with the foot for the following sixty years.

In October, 1938, he noted swelling of the right leg below the constricting band. About January, 1939, the edema spread above and below the constriction. It was accentuated by walking and standing, was relieved by rest and elevation of the leg and was usually associated with dull throbbing pain. The edema was still present when the patient was seen by me in March, 1939, because of a pruritic dermatitis on the right calf.

Physical examination showed the patient to be a well preserved man of seventy-two years, weighing 150 pounds. He walked with the aid of a cane. The physical examination was essentially negative except of the condition of the extremities.

The right hand (Fig. 1) had a constricting annular band around the first phalanx of the index and middle fingers with incomplete syndactylism of the fourth and fifth fingers. The left hand had similar annular crease-like bands around the first and second phalanges of the middle and ring fingers. The left index and fifth fingers were missing from the distal end of the metacarpal bones.

The right leg (Fig. 2) had an hour-glass appearance produced by a fibrous, scar-like constricting band completely around the junction of the middle and lower thirds. The measurements of the circumference of the leg were: above the band, thirteen inches; at the band, seven inches; and below the band, thirteen inches. The leg at the site of the band consisted essentially of the fibrous band and the two leg bones. The latter were easily palpated. The right foot had a bulbous appearance and the first two toes were only rudimentary structures. The dorsalis pedis and the tibial arteries were not palpable. The lower part of the left leg was normal and measured nine

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inches in circumference. The fourth and fifth left toes were absent and the second and third left toes had constricting annular creases over

Fig. 1. Partial syndactilism with annular crease formation and amputation of fingers.

Fig. 2. Hour-glass appearance of right leg following progressive vascular instability. Note the amputated stumps and malformation of digits of toes.

the middle phalanges. The movements of the feet were normal.

A complete survey was made of the skeleton. This revealed hypertrophic changes of the vertebrae and an increase in the number of small bones in the hands and feet. The bones of the right leg were negative. (Fig. 3.)

Oscillometric study[1] showed somewhat greater deflections than normal in the right foot but in the left foot they were normal. This meant that there was some organic obstruction to the blood flow in the right foot or there was a vascular spasm secondary to local change. There was actually a larger vascular bed in the right leg than in the left.

Laboratory studies including blood count, blood cholesterol, blood urea nitrogen and calcium were within normal limits. The Kolmer, Kahn and Kline reactions were negative.

Rest in bed made the leg smaller and a short walk induced slight edema. Excess walking, however, caused a relapse of the dull throbbing pains and a reappearance of the hour-glass contour of the right leg. Although there was a possible risk of injury to the tibial vessels, excision of the constricting band was advised to allow for better venous and arterial circulation. The patient refused any surgical interference.

ETIOLOGY

Defects similar to those in my patient have been classified by some recent authors under the general heading of spontaneous intra-uterine amputations. Many theories have been proposed to explain the development of constricting fibrous bands which may partially sever or completely amputate a finger, toe, arm or leg. The most important of the etiologic explanations of this congenital abnormality will be discussed briefly under the following heads: (1) ainhum; (2) relation to premature loss of amniotic fluid or to amniotic bands; (3) amputation by umbilical cord; (4) defective central nervous system development; (5) disturbance of the endocrine mechanism controlling bone formation; and (6) focal necrosis of limb bud tissue.

Ainhum (to saw or cut) recently studied by Horwits and Tunick[2] seems to be a process somewhat similar to that in my patient. This disease consists in a slow, gradual linear strangulation of one or more toes, especially the fourth and fifth and occasionally the fingers are involved, eventually resulting in spontaneous amputation. The groove or crease is usually located at the first interphalangeal joint. This condi-

tion is usually seen in negroes but has been reported in the white race. It may occur in childhood or in later life and, since it does not occur prenatally, differs from the case presented.

Fig. 3. Complete absence of any osseous change resulting from the fibrous encirclement.

Duncker,[3] Linzenmier and Brandes[4] believed that the premature loss of amniotic fluid was a likely cause of these deformities. Debrunner[5] and Berkely[6] thought that amniotic strips of bands may be traumatic and could cause amputation of the fingers, toes or extremities. Latta[7] held a somewhat similar opinion that bands of fibrous nonvascular tissues, apparently amniotic in origin, encircle the limbs at different times in fetal life. Rapid growth of these bands may cause progressive constriction until amputation is the result.

The possibility of the encircling of an extremity by the umbilical cord was emphasized by Battle,[8] Huguet[9] and many others. Abbe[10] believed that the digits of an infant cannot be amputated by a cord several times larger than a digit, even if it remained surrounding the extremity for some time. The popular idea of intrauterine amputation caused by the umbilical cord is held by the laity and many physicians today; but it seems logical to conclude that an umbilical cord, twisted about a limb with sufficient tension to produce amputation or crease formation, would so depress or completely obstruct fetal circulation as to result in fetal death.

Abbe was convinced that the association of such lesions as clubfoot, spina bifida or cranial anomalies with skin grooves strongly suggests that the so-called congenital amputation is really a condition of nondevelopment. This probably is due to a deficiency in the control of the developing tissues of the central nervous system.

It has been suggested by Dock[11] that the frequent association of amputation with other deformities raises the question as to the possibility of a disturbance of the endocrines which control bone formation and growth. There is no concrete evidence to support this view.

Streeter[12] in his excellent monograph stated that intra-uterine amputations are not due to constricting bands in utero, but are primary congenital changes due to abnormal constitution of the germ plasm. He believed that there is no evidence that intra-uterine amputation is due to amniotic bands, adhesions or mechanical constriction, but that there is a normal disparity in the quality of vitality of different tissues of the body, which is inherent in the germ plasm. Streeter also believes that a defective development of circumscribed areas of the limb bud tissues in the embryo are of such inferior quality that imperfect histogenesis occurs. Whether injured or defective in some way, these areas maintain themselves only through the earlier weeks of pregnancy. By the fourteenth week they become fibrous masses sloughing away from the normal adjoining tissues. At birth

an adjustment has been made and one finds traces of the damage in the form of depressions, grooves and healed stumps, occasionally with slender residual strands of hyalinized material still adhering to the affected regions. It is this material which has been mistaken for amniotic bands. In many cases in which annular zones are not deep enough to interrupt the circulation, the only defect is the presence of a crease.

The theory of germ plasm deficiencies has been further elaborated by Bagg[13] who followed descendants of mice treated with roentgen rays. These descendants showed a high percentage of congenital defects through several generations. Of 5,280 mice treated with roentgen rays which had been followed for a number of generations, 300 had clubfeet, many had polydactylism, hypodactylism and numerous other congenital defects, such as absence of kidney, testes, abnormal liver, or blindness, alone or associated with the above changes.

DISCUSSION AND SUMMARY

A case of spontaneous congenital amputation of the fingers with annular Ainhum-like bands and constriction of the distal portion of the leg with edema has been described. Theories for the possible explanation of the genesis of congenital bands and spontaneous amputations have been presented.

This congenital anomaly is a rarity in medical practice since similar cases in an embryological laboratory which receives many of the monstrosities and curiosities of medicine are conspicuous by their absence.

Streeter's theory that focal necrosis of the limb bud tissues occurs during the developmental embryonic stage seems the most plausible explanation. According to this theory the damage occurs during the first five weeks of embryonic life and the residua are apparent at birth. The absence of several fingers and toes in my patient may have occurred in early embryonic life as a result of focal necrosis. Other digits had cicatrizing bands but were not spontaneously amputated because the underlying process stopped in time.

The interesting feature of this congenital defect was the ability to live a normal life without earlier circulatory embarrassment. His present condition is probably the result of senility and weakened vascular bed, and not due to the presence of slowly progressive shrinking of the fibrous band that encircles his right leg. With increased edema and deficient vascular supply gangrene may later ensue.

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BILATERAL TRAUMATIC DIAPHRAGMATIC HERNIA

REPORT OF A CASE

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THOUGH occasional reports in the literature indicate that congenital or traumatic herniae of the diaphragm may extend across the midline, thereby being bilateral in the sense that the defect involves both sides, the incidence of separate herniae of the diaphragm which are bilateral is apparently exceedingly rare. We have been unable to find a report of a single case of bilateral traumatic diaphragmatic hernia of this type.

CASE REPORT

R. G. D., age 50, white, civil engineer, veteran officer of the World War, was admitted to Walter Reed General Hospital on January 6, 1939, for the treatment of "a hernia of the left side of the diaphragm which involved the pericardial sac." He had been injured in an automobile accident in April, 1934, at which time, fractures of the left ribs and the pelvis and a dislocation of the right shoulder had occurred. After six weeks' hospitalization he returned to his work without complaint. However, in October, 1934, while under treatment for urticaria, he was found to have a hernia of the left side of the diaphragm. Except for a feeling of fullness after eating, he had no complaint until about March, 1937, when he sought treatment because of gaseous abdominal distention and a sense of fullness before the completion of a meal. At this time he was examined and a gastrointestinal *x*-ray series showed that the pyloric portion of the stomach, the duodenum and the first portion of the jejunum were within the pericardial sac. There was approximately 50 per cent retention of barium in the stomach after five hours. On reëxamination in September, 1937, the hernial sac was found to be larger, with a portion of the transverse colon in the pericardial sac. Upon examination in June, 1939 the hernia was found to be even larger with a loop of transverse colon reaching the upper limits of the pericardial sac.

During the years 1937 and 1938, the patient had lost 50 pounds in weight, and had vomited occasionally after eating. During the last few months of 1938 the vomiting had increased in frequency. In December, 1938, he had a severe cold from which recovery was slow and accompanied by considerable loss of energy. Because of this complaint he decided to enter the hospital.

On admission he was found to have a normal temperature and a normal pulse and respiratory rate. He was ambulatory, though weak and in a state of moderate emaciation. Eyes, ears, nose and throat appeared normal. The mucous membranes were slightly pale. The skin was dry and showed evidence of loss of weight. The normal weight was 154 pounds, but the patient weighed only 104 pounds at the time of admission. There was no apparent abnormality of the glandular system. The peripheral vessels were of normal elasticity, the pulse was of poor volume and the pulse rate was rapid on exertion. The blood pressure was 100 systolic and 70 diastolic. Examination of the lungs showed marked diminution of breath sounds in the lower half of the chest on the left side; the lungs elsewhere were normal. The heart was difficult to outline by percussion though it was apparently within normal limits. The heart sounds were distant in the region of the apex but no murmurs or thrills were present. The abdomen was soft and no masses were palpable, though the left upper half was moderately distended. The veins of the abdominal wall in the epigastric region were prominent. No pathology was noted on examination of the nervous system, muscles, joints or osseous system.

Laboratory Data. The urine was found to contain one plus albumin and occasional leucocytes on repeated examinations. The specific gravity varied from 1.010 to 1.020. Blood count on admission showed 4,580,000 red cells per c.mm. with 80 per cent hemoglobin, and 8,400 leucocytes with 50 per cent lymphocytes.

1 per cent monocytes, 48 per cent neutrophilic and 1 per cent eosinophilic polymorphonuclear cells. The coagulation time was three and one-half minutes and the bleeding time two minutes. The Kahn reaction was negative. Electrocardiographic study indicated a regular sinus rhythm, a left axis deviation of 50 degrees and slight slurring of the QRS in lead II; the duration of the QRS was 0.12 seconds, indicative of defective intraventricular conduction. *X*-ray examinations, including gastrointestinal series, barium enema and examination of the chest (Fig. 1), showed a hernia of the left leaf of the diaphragm. The stomach was found to be within the abdominal cavity in the upright position but the pars pylorica and pars media were within the pericardial cavity in the prone position. The right leaf of the diaphragm was found to be elevated. The midportion of the transverse colon passed through the diaphragm and ascended to the level of the third rib. On lateral examination the portion of the transverse colon within the chest was seen anterior to the heart. (Fig. 2.) The lungs were free of pathologic changes, and the aorta and heart were in normal position.

During the first two weeks in the hospital the patient vomited frequently after meals and on January 29, 1939, the blood chemistry determinations showed urea nitrogen 78.94, sugar 90.9, chlorides 297 and creatinine 3 mg. per 100 cc. of blood. The CO_2 combining power was 47.5 volumes per cent. After the intravenous administration of hypertonic saline solution and 5 per cent glucose in normal saline solution, the blood chloride level was increased to 412.5 while the urea nitrogen decreased to 42.85 and creatinine to 2.6 mg. per 100 cc. of blood. This aided materially in decreasing the frequency of vomiting.

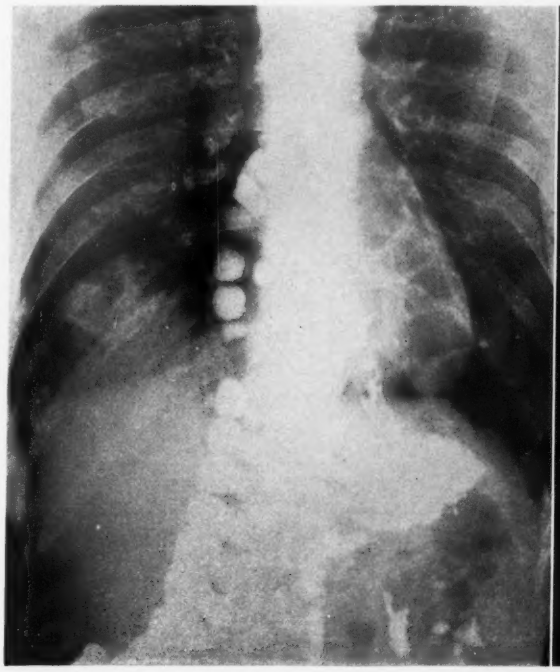

FIG. 1. Barium enema before operation, showing presence of the transverse colon in the pericardial sac. (Courtesy of Dr. F. M. McChesney and Dr. Claude Moore.)

FIG. 2. Lateral view of the chest before operation and after a barium enema, showing the position of the colon in the pericardial sac.

On February 6, 1939, a left phrenemphrexis was done under local anesthesia. *X*-ray examinations on February 9, 1939, demonstrated a paralysis of the left diaphragm.

On February 17, 1939, at operation under spinal (novocaine-nupercaine) anesthesia, an opening was made into the abdominal cavity through a left upper abdominal incision which paralleled the left costal margin. A very large defect was found in the left diaphragm which would admit the entire hand. The distal half of the stomach, approximately 15 inches of the transverse colon and practically the entire omentum had herniated into the pericardial sac, the omentum being adherent to the pericardium and the lateral and posterior portions of the epicardium of the left ventricle. The

defect was about 12 cm. in length. High up in the left side of the chest a small adhesion could be visualized in the region of the upper lobe.

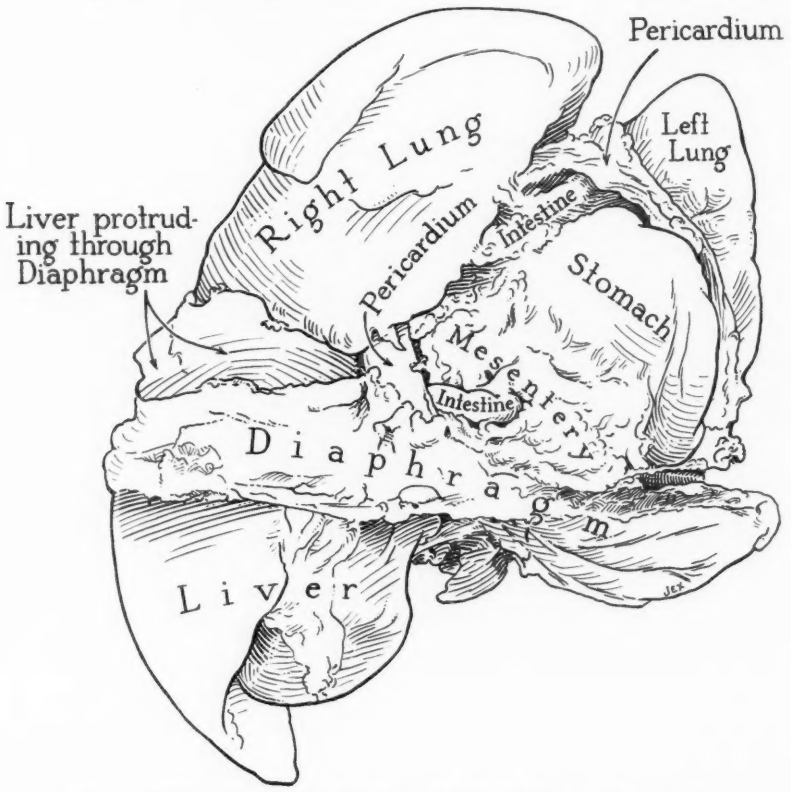

Fig. 3. Drawing to indicate structures as viewed at operation.

The left lung was collapsed. The adherent omentum, stomach and transverse colon were released from the margins of the defect and from the pericardium, epicardium and pleura and dropped into the abdominal cavity. An attempt was made to remove all remaining adherent tissue from the pericardial sac. The diaphragm was closed with interrupted silk sutures and the abdomen closed without drainage. Figure 3 illustrates condition found at operation.

Throughout the operation the patient's general condition was good. Prior to operation the blood pressure was 110/72. Ephedrine sulfate, 48 mg., was administered prior to the spinal anesthesia and 1 cc. of coramine was given after twenty-seven minutes of anesthesia, resulting in maintenance of the blood pressure between 74/46 and 142/80. The anesthesia was satisfactory throughout the operation and at the end the blood pressure was 102/68. Two hours after operation a transfusion of 500 cc. of citrated whole blood was given.

Convalescence was exceptionally smooth during the first forty-eight hours. The temperature varied from 98.8°F. to 99.4°F., the pulse from 112 to 128 per minute and the respirations from 18 to 28 per minute. On the morning of February 19, however, there was considerable respiratory difficulty. Clinical and *x*-ray examinations showed that pneumothorax of the right side had resulted in compression of the right lung to about two-thirds normal size. Also a mild pneumothorax of the left side existed, with evidence of slight atelectasis throughout the left lung. Intrapleural pressure of the right side was found to be minus 2.5 to plus 2.5, and after aspiration of 925 cc. of air the pressure varied from minus 1.5 to minus 4.5. The aspiration resulted in marked improvement and the patient was taken from the oxygen tent which had been in use during respiratory embarrassment. The following morning an *x*-ray examination of the chest demonstrated an increase in the pericardial shadow and the presence of a small amount of fluid in the left pleural cavity. During the day of February 20, the pulse varied from 94 to 128 per minute and the respirations from 20 to 30 per minute. About 8:00 P.M. there was a radical change in the patient's condition, associated with paleness, rapid respiration and a weak thready pulse. After aspiration of 450 cc. of

air from the left pleural cavity, there was marked improvement and, with the aid of an oxygen tent, the patient was fairly comfortable.

hesions anteriorly it was found that there was a delicate line of adhesion to the anterior margin of a rupture of the diaphragm approximately

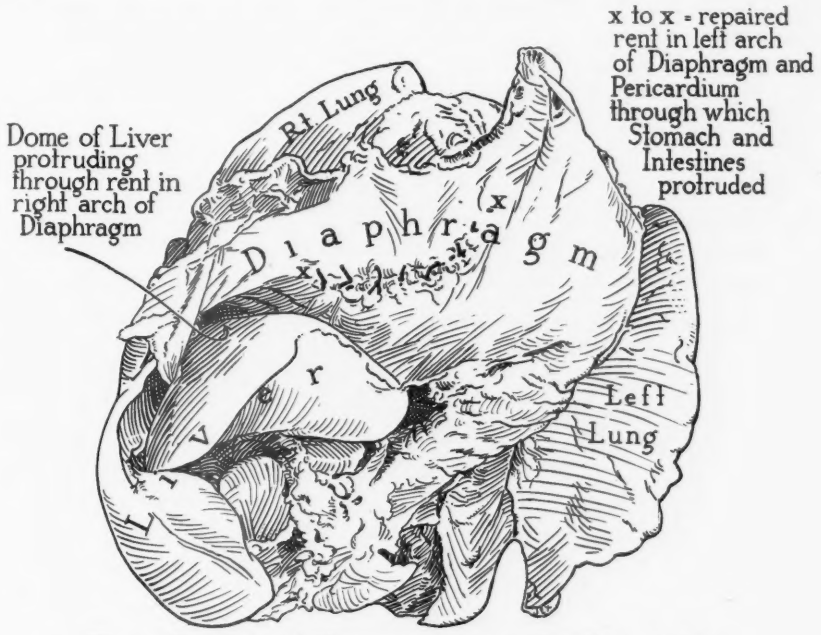
x to x = repaired rent in left arch of Diaphragm and Pericardium through which Stomach and Intestines protruded
Dome of Liver protruding through rent in right arch of Diaphragm
Rt. Lung
Diaphragm
Liver
Left Lung

Fig. 4. Drawing to indicate structures as viewed at autopsy.

At 4:55 A.M., February 21, he failed rapidly, respirations failed at 5:05 A.M. and the heart ceased beating at 5:07.

Autopsy report (by Colonel G. R. Callender), disclosed a small pocket of grumous material beneath the operative wound, completely walled off by adherent transverse colon. The pericardial sac was laxly filled with bloody fluid. There was a mass of omentum approximately 8 cm. from above downward, 3 cm. from before backward and 1 cm. thick, adherent to the right lateral wall within the pericardium, and a similar mass, somewhat larger, on the left wall at the apex. Sutures were tied around the lower extremity of these two masses. The heart was adherent by dense fibrous adhesions just posterior to the suture line, the adhesions covering an area approximately 12 cm. in diameter, of the lateral and posterior epicardium. Firm fibrin covered the rest of the epicardium which was blood stained and rather fatty.

Both lungs were collapsed and both cavities contained air and about 300 cc. of bloody fluid each. There was one delicate fibrous adhesion from the lateral surface of the upper lobe to the anterior chest wall on the left. The right lung appeared adherent over the dome of the diaphragm, but on separating these adhesions anteriorly it was found that there was a delicate line of adhesion to the anterior margin of a rupture of the diaphragm approximately 15 cm. in diameter. Posteriorly the base of the right lung was adherent to the dome of the liver which projected through the diaphragm and was adherent to it except where the lung adhered to the diaphragm anteriorly. From the medial point of the anterior pulmonary diaphragmatic adhesions to the right margin of the pericardium, was a space free from any adhesion, making an opening between the pleural and peritoneal cavities. The projecting mass of liver had been compressed by the margins of the opening in the diaphragm so that it was partially separated by a fissure from the rest of the right lobe. The right lung was less atelectatic than the left. Figure 4 illustrates the condition found at autopsy.

The stomach was closely adherent for a distance of 10 cm. in the transverse portion of the greater curvature to the transverse colon between the two masses of omentum. These two structures showed points of separation of adhesions and apparently were the portions of stomach and colon found in the pericardial cavity. The rest of the gastrointestinal tract appeared essentially normal.

The liver pulp was somewhat yellowish and opaque. The gallbladder was distended with dark bile and the bile ducts appeared normal.

The spleen, weighing 160 Gm., showed marked acute passive congestion.

The final diagnosis was: bilateral, severe, traumatic diaphragmatic hernia, involving the pericardial sac and pleural cavity on the left with herniation of the transverse colon, omentum and lower half of the stomach, and involving the pleural cavity on the right with herniation of the dome of the liver; hemopneumothorax, bilateral; and hemopericardium, moderate, secondary to operation.

DISCUSSION

One of the most interesting features of this case is the presence of bilateral diaphragmatic lacerations in a man who lived for four years and ten months after injury, in whom a definite diagnosis of left diaphragmatic hernia was made prior to operation but in whom the presence of defect in the right side was unsuspected. At the time the patient developed collapse of the right lung after operation, it was suspected that the laceration had extended through the interthoracic septum. Though the pressure on the herniated portion of the liver had resulted in a deep sulcus, there was no other evidence of ill effect from the hernia of the right side. The introduction of air into the right pleural space at operation upon opening the abdomen caused collapse of the right lung. It is believed that recovery from operation would have resulted had this additional complication not occurred.

SUMMARY

A case of bilateral traumatic hernia of the diaphragm is presented with operative and autopsy findings, in which herniation of the stomach, omentum, and transverse colon occurred into the pericardial cavity on the left side through a defect of approximately 12 cm. and in which herniation of the dome of the liver occurred into the pleural cavity on the right side through a defect approximately 15 cm. in diameter.

TREATMENT OF FRACTURES OF THE SHAFT OF THE FEMUR BY DOUBLE WIRE TRACTION

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THE use of skeletal traction in the treatment of fractures of the femur has come into general use since the first World War. Calipers or ice tongs which were first used were succeeded by Steinmann pins and since Kirschner introduced his wire in 1923, it has become the most popular method. The Kirschner wire is easily drilled through the bone and the number of cases of bone infection produced is definitely less than when the former methods were in vogue.

Since 1935, the routine method of handling fractures of the shaft of the femur on the author's service at The Charleston General Hospital has been to insert a Kirschner wire through the distal fragment above the knee and apply traction through the bow, with the leg held in a Thomas splint and Pearson attachment. It was found that in many cases upward bowing of the distal fragment persisted in spite of manipulation, change of angle at the knee and reduction of weight. Open reduction was done in these cases until early in 1939, when it was conceived that if a second wire were placed through the proximal end of the distal fragment and traction made in a downward direction, toward the bed, reduction would be accomplished. Similarly in cases in which the distal fragment remains displaced posteriorly, traction on a second wire in an upward direction would produce the necessary correction. This method has been used to date in six cases with entirely satisfactory results.

A reasonably complete review of the available American and English literature reveals that no one has described this method before. In the latest edition of his book on fractures, Scudder mentions that H. E. Santee applied calipers to the condyles of the femur pulling upward toward the ceiling, with another pair of calipers pulling longitudinally from the head of the tibia in cases of persistent posterior displacement of the distal fragment.

CASE REPORTS

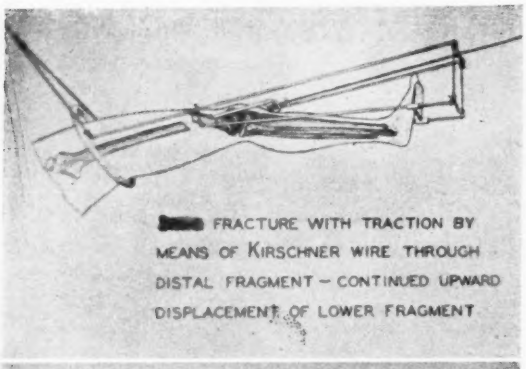
CASE 1. P. F., a white male, age thirty-five years, suffered a serrated fracture of the middle third of the shaft of the right femur and fractures of the five to the eight ribs on the right, in a fall of slate while at work in a coal mine on March 6, 1939. The following day, a Kirschner wire was inserted through the distal fragment and the leg placed in a Thomas splint with a Pearson attachment. Roentgenograms revealed persistent anterior bowing of the distal fragment which was not corrected by straightening the knee or using a pressure pad.

On March 14, 1939, under sodium pentothal anesthesia, the fracture was manipulated but no improvement was noted by fluoroscopic examination. Immediately, a second Kirschner wire was inserted through the proximal end of the distal fragment and twenty pounds of weight were tied to the bow with the pull toward the bed. This produced bowing in the opposite direction, but when some of the weight was removed it caused loss of contact of the fragments. Therefore, a slight degree of posterior bowing was accepted. On June 16, 1939, three months after the accident, the bows and wires were removed and a walking caliper brace applied. The patient left the Hospital on June 29, 1939, 115 days after the accident. Good union of the fracture resulted, but because of the long period of immobilization, the knee would never flex beyond 120 degrees and on May 6, 1940, a Bennett quadriceps lengthening operation was done. When last examined on August 19, 1940, he had active extension to 165 degrees. The leg was strong and he walked without support. No infection developed around the wires, the legs were the same length

and the posterior bowing of the femur was not visible in this case.*

Case II. J. A. R., a white male, age thirty-

Fig. 1.


FRACTURE WITH TRACTION BY MEANS OF KIRSCHNER WIRE THROUGH DISTAL FRAGMENT – CONTINUED UPWARD DISPLACEMENT OF LOWER FRAGMENT

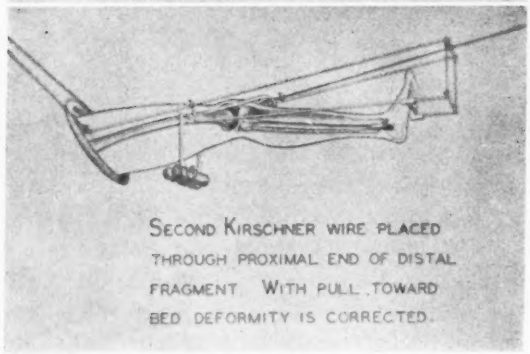
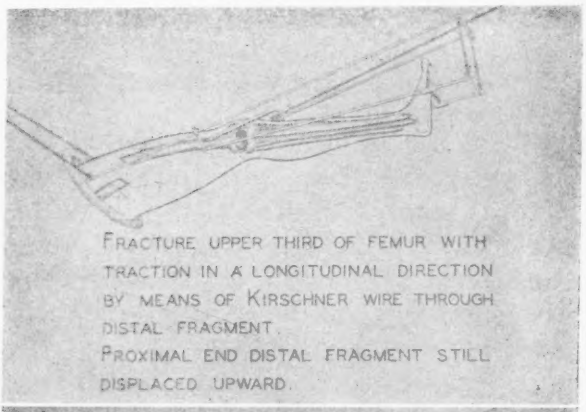


Fig. 2.

nine years, suffered a transverse fracture of the middle third of the shaft of the right femur on March 29, 1939, when he was struck by a timber while at work in a coal mine. It was treated in the usual manner by a Kirschner wire through the distal fragment. Fairly good position resulted, there being slight anterior bowing and lateral deviation of the distal fragment. Union apparently was progressing satisfactorily and weekly roentgenograms showed good position until the latter part of May when it was noted that further lateral deviation of the distal fragment was occurring. The rope which had been tied to the center of the bow was shifted to the medial side in an attempt to correct this. This produced still further anterior bowing of the fracture site. Straightening the knee, pressure pads and manipulation failed to correct the deformity. (Fig. 1.) On June 2, 1939, under local anesthesia, a second wire was drilled through the proximal end of the distal fragment and ten pounds of weight were added. This pulled down the displaced fragment into practically perfect position (Fig. 2) and solid union resulted. The patient left the hospital with a brace on July 7, 1939, 100 days after the accident. His recovery was rapid and he returned to work on March 12, 1940, eleven and one-half months after the accident. At this time, his legs were of the same length and his knee flexed to 80 degrees. No infection developed around the wires.

Fig. 3.


FRACTURE UPPER THIRD OF FEMUR WITH TRACTION IN A LONGITUDINAL DIRECTION BY MEANS OF KIRSCHNER WIRE THROUGH DISTAL FRAGMENT.
PROXIMAL END DISTAL FRAGMENT STILL DISPLACED UPWARD.

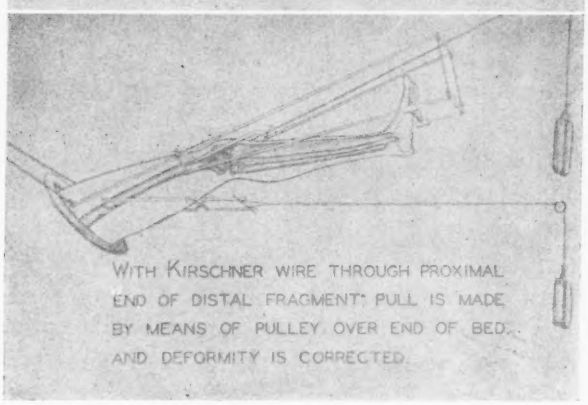

WITH KIRSCHNER WIRE THROUGH PROXIMAL END OF DISTAL FRAGMENT PULL IS MADE BY MEANS OF PULLEY OVER END OF BED AND DEFORMITY IS CORRECTED.

Fig. 4.

Case III. C. M., a white male, age twenty-six years, suffered a severely comminuted fracture of the shaft of the left femur and dislocation of the right hip with a fracture of the right acetabulum in a fall of slate while working in a coal mine on August 1, 1939. Under ether anesthesia, the dislocation of the right hip was reduced and Kirschner wires placed through the distal ends of both femurs and the left placed in Thomas splints with Pearson attachments. Persistent anterior bowing of the distal fragment of the left femur resulted and on August 10, 1939, a second wire was inserted through the proximal end of the distal fragment. This pulled the fragment into line very well. The patient left the hospital wearing a caliper brace on October 28, 1939, eighty-eight days after the injury.

* This patient when last examined on April 3, 1941, had active flexion to 70 degrees.

The left femur went on to complete healing but his progress has been impeded by the increasing stiffness of the right hip due to the acetabular fracture. When last seen on August 19, 1940, both the left knee and hip showed active flexion to 90 degrees. His chief difficulty at that time was stiffness of the right hip due to the acetabular fracture. No infection developed about the wires in this case. This man of course is still unable to work.*

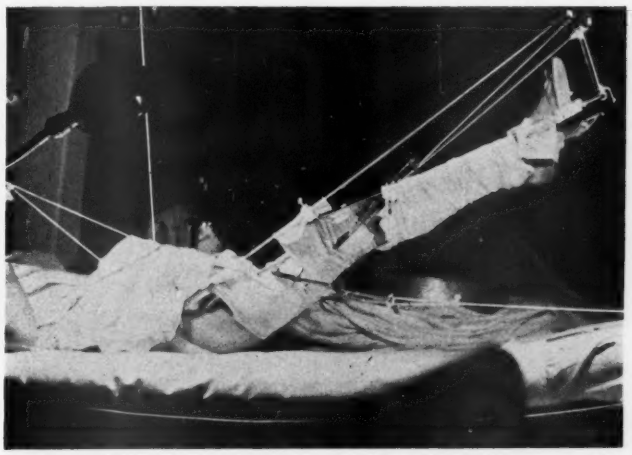


Fig. 5. Showing fracture of upper third of femur treated by two wire traction.

Case iv. R. W., a white male, age twenty-five, suffered a transverse fracture of the middle third of the left femur on August 8, 1939, in a fall of slate in a coal mine. He was treated in the usual manner but anterior bowing of the distal fragment persisted. The second wire inserted on August 16, 1939, was too near the proximal end of the fragment and pulled out, so a third wire was inserted on August 23, 1939. This effected good position of the fragments and the patient left the hospital wearing a brace on November 2, 1939, eighty-six days after the accident. Slight infection developed around the wire holes in this case. Union resulted and the patient returned to work on April 8, 1940, eight months after his accident. When last examined on July 13, 1940, the wounds were healed and he was working regularly as a mine foreman.

Case v. F. L., a white male, age twenty-two years, suffered a serrated fracture of the upper third of the right femur on September 25, 1939, when he was run over by a mine car while at work in a coal mine. He was treated in the usual manner but anterior bowing of the distal fragment persisted (Fig. 3), and on September 30, 1939, a second wire was inserted through the proximal end of the distal fragment. Because the fracture was so high, it was impracticable to tie weights to the bow as they would rest on the bed. Therefore, a rope was tied to the bow and traction was made by a pulley attached to the lower end of the bed just above the mattress. (Figs. 4 and 5.) This effected a very good result and the patient left the hospital on November 29, 1939, sixty-five days after his accident.

Some drainage of pus has persisted from the medial side of the upper wire hole in this case. Because of persistent drainage and the presence of a sequestrum as shown by *x*-ray, a sequestrectomy was done on July 24, 1940. He was last seen on August 5, 1940, when there was only very slight drainage from the wound. The legs were of the same length and he was certified as being ready to return to his regular work.

Case vi. J. I., a white male, age fifty-nine years, suffered a comminuted fracture of the distal end of the left femur on June 24, 1940, when his leg was struck by a piece of coal. Longitudinal traction was made by a Kirschner wire through the proximal end of the tibia the same day. Roentgenograms afterward showed persistent posterior displacement of the distal fragment. On July 3, 1940, under local anesthesia, a second wire was placed through the proximal end of the distal fragment and pull made vertically upward with ten pounds of weight. Following this, roent-

* When last examined on February 3, 1941, the left hip flexed to 90 degrees and the knee flexed to 70 degrees. He still had some stiffness of the right hip but went to work a few days afterward.

genograms showed perfect replacement of this fragment. Healing took place satisfactorily and on August 19, 1940, a double spica cast was applied which he is still wearing.*

In the literature, no mention is made of persistent anterior displacement of the distal fragment. On the contrary, the common deformity recorded is persistent posterior displacement of the distal fragment which is thought to be due to the pull of the gastrocnemius muscle. The reason for the anterior displacement of the distal fragments in our first five cases is not clear. In some of the roentgenograms overpull is shown, but reducing the weight did not correct the deformity in any case. It might be thought that if the original Kirschner wire was placed too far anteriorly, such displacement might occur. The roentgenograms were carefully checked with this in mind. Two wires were exactly in the center of the shaft, two were slightly posterior to the center and one was slightly anterior. So, this could not be the factor. Excessive knee flexion might be blamed but in each case the knee was fully extended without help in correcting the displacement.

I personally treated twenty patients with fractures of the shaft of the femur in the year 1939. Thirteen were adults and seven children. In three cases, Russell traction was used; two patients were adults and one a child. All of the authors writing about Russell traction stress the fact that it is useless in fractures of the lower third of the femur. Our experience with it is not great but its field does not interfere with that covered by the two-wire traction method.

The two-wire traction method may be used equally well in fractures in which the distal fragment remains persistently posterior. The pull in these cases is made vertically upward, and accurate reposition of the fragments is obtained as is shown in Case VI.

In hospitals in large cities and centers where operative technic and assistants are of the best, there does not exist the urgent need for nonoperative methods of treatment of fractures. But in smaller cities and towns where it is extremely difficult to get well trained assistants and nurses, infection following bone operations is common, and any method designed to avoid open operation should be encouraged. I regret our two cases of infection of wire holes. One has cleared up but the other still drains slightly. With greater care this can be avoided.

CONCLUSIONS

A method is presented in which two Kirschner wires are used for the correction of fractures of the shaft of the femur with persistent anterior or posterior bowing of the distal fragment.*

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Scudder, C. L. The Treatment of Fractures. 11 ed., p. 912. Philadelphia, 1938. W. B. Saunders Co.

* Good union of the fracture resulted and when last seen on April 5, 1941, he had knee flexion to 90 degrees and was making good progress toward complete recovery.

* Since the writing of the paper two more patients have been treated by this method. In addition to the two wires previously used, however, a third wire was used in each of these cases. Pull ventrally was made on the distal end of the proximal fragment and pull dorsally was made on the proximal end of the distal fragment in each case. The results have been good.

CHRONIC ULCERATIVE COLITIS WITH PSYCHOSIS*

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THE association of chronic ulcerative colitis with mental abnormalities has received considerable attention in the recent literature. Brown, Preu and Sullivan[1] are of the opinion that patients with the disease are of a personality type characterized by lability and a tendency to surrender in the face of difficulties. Wittkower[2] in his study of forty unselected cases found that thirty-seven had psychological abnormalities or disorders. No important etiologic relation has been established between mental disease and chronic ulcerative colitis although it has been suggested that exacerbations of the colitis may follow psychic disturbances. There can be no doubt, however, that the distressing situation of patients with severe ulcerative colitis offers justifiable cause for mental depression. Whether true psychosis is more common in the patient with colitis we do not know.

In the case herewith reported, major psychosis developed in a patient with intractable ulcerative colitis and was relieved after surgical removal of the colon.

CASE REPORT

A married woman, age twenty-seven years, with severe ulcerative colitis of one year's duration, was seen in consultation by one of us (L. W. G.) because she had developed serious mental symptoms. The disease had begun about eight weeks after delivery of a normal child. The delivery was said to have been difficult and convulsions were noted at the time. Several postpartum hemorrhages had occurred. Marked bloody diarrhea with anemia and wasting ensued. A rectovaginal fistula developed four months after the beginning of colitis and an attempted repair was unsuccessful. Her condition became worse and eight months after the disease had begun a tangential ileostomy had been performed elsewhere. After ileostomy some improvement was noted but bleeding persisted and secondary anemia was controlled by blood transfusions, twenty-four of which had been given. Soon after the operation of ileostomy the patient first demonstrated mental symptoms in the form of auditory and visual hallucinations. Delusions were present but at times she seemed to have insight.

The patient came under our observation in August, 1938. At the time of admission to the Albany Hospital she was in a catatonic state. Ulcerative colitis had been present one year. She exhibited cerea flexibilitas and responded to no normal stimuli. A psychiatric consultant made the diagnosis of catatonic type of schizophrenia.

Physical Examination. The patient was emaciated and there was marked pallor. A rectovaginal communication which discharged blood and pus was found. The tangential ileostomy was functioning well. Edema of both extremities was noted. The patient's temperature varied from normal to 100°F. and her pulse was from 100 to 120 bears per minute.

Laboratory Findings. Proctoscopic examination revealed advanced ulcerative colitis with marked bowel contraction and secondary polyposis. Roentgenograms after barium enema showed typical advanced ulcerative colitis involving the entire colon. The stools were negative for parasites and ova. The red blood cells numbered 3,250,000 per cu. mm. and the value for hemoglobin was 45 per cent Sahli. The value for serum proteins was low (4.6 mg. per 100 cc. of blood).

Surgical treatment was undertaken and after preliminary transfusions a terminal type of ileostomy was made to replace the existing tangential one. The operation was performed under cyclopropane anesthesia. Immediately following this operation there was a period of mental clarity followed by regression during convalescence. The mental state, however, never returned to its former severity and there was slight immediate improvement. Stupor was not so profound and the patient seemed to understand at times. Progressive improvement in the mental state, however, did not follow.

Bleeding from the colon and persistent anemia continued and four months after the

* From the Departments of Surgery and Medicine of the Albany Medical College and the Albany Hospital.

establishment of the new ileostomy the red blood cells numbered 2,450,000 and the value for hemoglobin was 55 per cent. Colectomy was then performed at this time through an incision slightly to the right of the midline, extending from above the symphysis pubis to a point half-way between the xyphoid process and the umbilicus. The colon was removed down to the region of the lower sigmoid above the superior hemorrhoidal artery. The end of the sigmoid was inverted with some difficulty. Drains were placed in both colonic gutters. Cyclopropane anesthesia was used. Figure 1 is a photograph of the specimen removed.

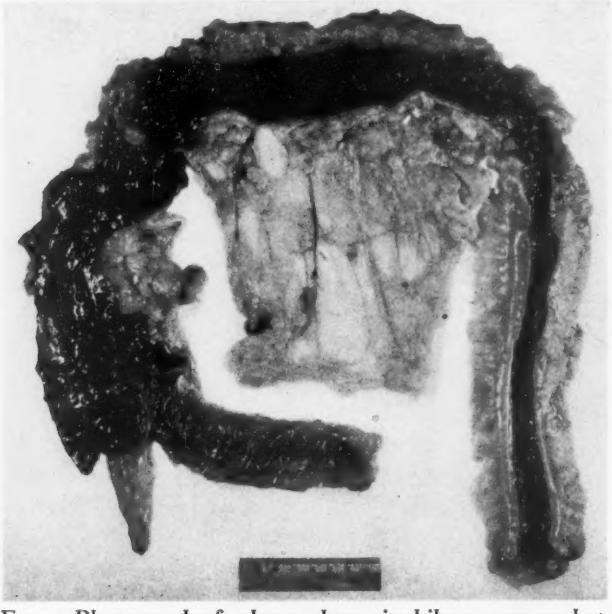

FIG. 1. Photograph of colon and terminal ileum removed at operation.

Steady improvement in health and in mental symptoms followed colectomy. There was only very slight loss of blood from the rectal stump. Further transfusions of blood became unnecessary. At the time of dismissal from the hospital the patient was walking about and seemed much improved. There was some apprehension and auditory hallucinations were still present, though to a less degree. Soon after returning to her home, all mental abnormalities were lost as far as the patient's family could tell. We have seen the patient on several occasions during the year since operation and have found her a normal, healthy woman, interested in her family and in life in general. She has gained fifty pounds and her relatives detect no return of the psychosis. The ileostomy dejecta have lost their fluid nature and give little trouble. The patient engages in normal activities.

Examination by a psychiatrist confirmed our opinion that the patient has an excellent remission from her mental disease. A slight euphoria, frequently seen in the later stages of recovery from this psychosis is still present. Delusions and hallucinations have disappeared.

The association of serious psychosis in this patient with ulcerative colitis seemed to us to indicate radical treatment for the disease. A return to normal health with the relief of anaemia may have been a factor in bringing about mental improvement. What part anaesthesia had in alleviation of the psychosis we cannot say. In this case surgical interference during a psychotic episode did not make the mental state worse at any time. Relief of the physical ailment was attended by rehabilitation of the individual to a useful life.

SUMMARY

The manuscript includes a report of the case history of a patient with chronic ulcerative colitis in whom schizophrenia, catatonic type, developed. Psychosis disappeared and mental health was restored with improvement in the patient's condition after a two-stage operation in which the diseased colon was removed.

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OBSTRUCTING CHRONIC CICATRICIAL ENTERITIS TREATED WITH SIMPLE LATERAL ANASTOMOSIS*

TEN YEAR FOLLOW-UP

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BROOKLYN, NEW YORK

CONSIDERABLE data are now available which point to the fact that regional ileitis is increasing. The marked increase in the number of cases now seen cannot be wholly explained by the fact that the entity is better known and the profession more alert to its diagnosis. Pemberton of the Mayo Clinic in a personal communication states: "In December, 1936, I reported all the cases of regional enteritis seen at the Clinic in the fifteen year period 1922 to 1936 inclusive. There were thirty-nine cases, and at that time I attributed the increased incidence in recent years to an increased alertness on the part of the clinician and the roentgenologist in recognizing the disease. However, in the past thirty months we have seen sixty-eight cases, that is, there have been almost twice as many cases in the last three years as in the prior fifteen years. I now feel very definitely that the disease is on the increase."

Although Braun and Le Denty, in 1909, and Wilensky and Moschowitz, in 1923, reported important data, it was not until 1932 that Crohn, Ginsberg and Oppenheimer definitely established the entity of regional ileitis. Observations by Bargen, Brown and Weber showed that the lesion was not always confined to the terminal ileum and also suggested the term, "regional ileitis." The confusion that has existed regarding the disease is well expressed by the various stages that evolved in naming this clinical entity as, first, terminal ileitis, then regional ileitis, this supplanted by regional enteritis and now more commonly recognized as chronic cicatricial enteritis.

Dixon, in an analysis of a series of sixty-nine cases, was lead to the inevitable conclusion that the treatment of choice is radical removal of the involved tissue. Mixter in a very comprehensive survey of 363 cases collected from questionnaires sent to twenty-seven surgeons came to the conclusion that "radical surgical resection in one or more stages should be instituted." Jackson commenting upon proper surgical treatment states that it is still unsettled until late results of cases in which patients have been operated upon have been studied. Woolsey states that the treatment is essentially surgical, with conservatism as to resection. Cutler's point of view is definitely conservative.

Although the etiology is still not known, enough time has elapsed to evaluate the current modes of treatment and to draw some conclusions regarding them. In the main, two types of therapy have been used, medical and surgical; the former is of little value in the definitely obstructed type of disease and at this stage the vast majority require surgical interference. The commonly accepted surgical procedure is a resection of the obstructed area and a determination to go well beyond this area to get healthy tissue. In evaluating the end results of such resections, one is confronted with a very vital question: Does this radical procedure with its added risk give justifiable good results? Unfortunately, in spite of the theoretical soundness of this plan, recurrences of the disease are still reported. The result of the questionnaire sent out by Mixter showed the surgical mortality to be 14 per cent in a series of 278 cases in which the patients had been

* From the Grace Clinic, Brooklyn, New York.

subjected to major surgical procedures, mostly radical resections. In an analysis of other material collected by the same author

CASE REPORT

The patient, T. K., age thirty-seven, Italian extraction, was seen at the Grace Clinic on

Fig. 1. Fig. 2.

Fig. 1. Illustration showing patient before operation.
Fig. 2. Illustration showing patient after operation.

the surgical mortality was 20 per cent. From a brief analysis of collected material to date, two fundamentals stand out: (1) radical resection is still associated with many recurrences and, (2) reported mortality is between 14 and 20 per cent.

In an effort to add a small piece of evidence to the accumulated data on this interesting disease, the case of the following patient treated by simple ileocolostomy is reported, with a ten year follow-up:

February 24, 1930, at which time she complained chiefly of diarrhea and a nauseated feeling, symptoms which she had first noticed in the autumn of 1928. At that time she visited a local doctor. Because she did not seem to get relief from his prescribed treatment and because abdominal pains became more distressing and frequent, she visited another doctor in the early part of 1929. A diagnosis of chronic appendicitis was made and the patient underwent an appendicectomy. However, less than six months postoperatively the abdominal

pains recurred with alarming intensity. After being treated for another six months with periodic relief, she visited the Clinic. At this time, the patient stated that from 1928 until the present time, 1930, she had never had the slightest trace of abnormal temperature, appetite had been good during the intervals when pain was not present; but immediately after eating the pains would become acute, all nourishment would be vomited and at times the vomitus was almost fecal in character. During severe attacks, the muscular contractions of the intestine were plainly visible, "squirming and turning like a tortured snake beneath the skin." During the past six months hypodermics of codeine and morphine had been used to relieve the severe abdominal pain; however, these hypodermics had become ineffectual just prior to coming to the Clinic. Frequent high colonic irrigations were used unsuccessfully. During the past year the patient had experienced considerable loss of weight, from 115 pounds to fifty-nine pounds.

Physical examinations revealed an emaciated, dehydrated, cachectic female weighing fifty-nine pounds, with marked distention of the abdomen, apparently small bowel obstruction. The blood count showed: hemoglobin 61 per cent; red blood cells, 4,150,000; polys 55 per cent; lymphocytes 44 per cent; eosinophiles 1 per cent. A working diagnosis of chronic ulcerative colitis was made; however, all studies done to confirm this diagnosis were negative.

X-ray of the stomach showed: "7 hours after barium meal, head of meal is in terminal ileum which is displaced to the left, and dilated. This points to an obstructive lesion in the terminal ileum, most likely due to adhesions. Twenty-four hour film shows opaque meal in colon; cecum is not greatly deformed. There is still some barium in terminal ileum and dilation of ileum. This points to a non tb. partial obstruction of terminal ileum."

On April 9, 1930, a side-to-side ileocolostomy was done to relieve the obstruction in the ileum. Exploration of a mass which was continuous with the dilated ileum showed it to be an agglutinated assemblage of fibrotic and stenosed bowel all matted down in the right lower quadrant of the abdominal cavity. The lumen of the ileum proximal to the obstruction was distended four or five times its normal diameter and markedly hypertrophied. Although a biopsy specimen was not removed at the time of operation, we believe that the classical history for chronic cicatricial enteritis, the *x*-ray confirmation of obstruction and the operative findings permit one to venture the diagnosis of probable chronic cicatricial enteritis.

The patient was last seen ten years postoperatively. She appears to be in perfect health, has no complaints, weighs 133 pounds and *x*-ray study was negative except for some irregularity in the area of the cecum. The patient is carrying on the responsibility of a large household and seems in excellent physical condition. This patient now (April 3, 1941) is enjoying good health.

CONCLUSION

In view of the excellent result ten years after conservative measure of ileocolostomy, this case should be added to the accumulating evidence warranting an open mind toward conservative therapy in this type of disease.

CROSSED RENAL ECTOPIA

CASE REPORT

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ALTHOUGH not rare in its occurrence, crossed renal ectopia is definitely uncommon. To date, 161 cases have been reported, to which another is now added. The case presented is unusual because of the presence of a pneumococcus pyelitis and that negative cultures were obtained following administration of sulfapyridine. No such case can be found in the literature.

Beer and Hagman estimate the occurrence of crossed ectopia as one in 8,000 cases. Stuart and Lodge found it only once in 6,500 autopsies. The condition is more frequently seen in males; the right kidney is more frequently displaced than the left.

CASE REPORT

J. S., case #59183, a white male, aged twenty, was admitted to the Opthalmologic Service at Temple University Hospital, suffering with a painful inflammation of one eye for a period of three months. He gave a history of having had a pyelitis at eight years of age, with recurrences to the present date. Urinalysis revealed 2–4 leucocytes and 2–3 red cells a field.

Cystoscopy, April 24, 1939, revealed considerable pus and débris floating in a rather distorted vesical cavity. The vesical mucous membrane was acutely inflamed. The right ureter was located not on the interureteric ridge but on the lateral wall of the vesical neck. This was catheterized and a specimen taken for culture. The left ureteric orifice could not be located. Indigo carmine was eliminated from the right ureter in three minutes; none was observed as coming from the left ureter.

Urine culture, April 26, 1939, of specimen taken from right ureter was reported as negative for tubercle bacillus but showed a definite growth of pneumococci, type 19, and Bacillus proteus.

Sulfapyridine, grains 15, was given four times a day. On May 6, 1939, urine culture was reported as showing Bacillus proteus and pneumococci.

A culture report four days later, was negative for Bacillus proteus and pneumococci. Subsequent repeated cultures have revealed similar findings.

Summary of the Roentgen Findings on the Intravenous Pyelographic Studies, and Retrograde Pyelographic Findings. Preliminary films of the abdomen show a calculus in the upper half of the left kidney, measuring about ½ by 1 cm. The left kidney shadow is fairly well visualized and appears unusually large, the lower pole reaching to within 1 cm. of the left iliac crest. There is no evidence of a kidney shadow on the right side. There is evidence of congenital maldevelopment in the lumbosacral region. This appears as a partial lumbarization of the first sacral segment with deformity. The laminae of the first sacral segment are not fused posteriorly and the lumbosacral zygapophysial joints are situated at different levels on the right and left sides, causing a tilting of the fifth lumbar vertebra toward the left and a compensatory mild scoliosis of the lumbar spine.

Films made five and fifteen minutes after the intravenous injection of 20 cc. of diodrast solution show a well filled system of renal calyces on the left side, connected to a small pelvis and single ureter. The superior and inferior groups of calyces appear to be separated more than usual, the upper limit of the most superior calyx lying 10 cm. above the lower limit of the most inferior. In addition, the system of calyces appears somewhat crowded from side to side, and shows slight lateral displacement together with 90 degrees abnormal rotation, diminutive pelvis and the ureter pointing anteriorly.

Films made forty-five minutes after injection (Fig. 1), following removal of the compression block, show some addition and irregular dye collections mesial to the pre-

viously described system. These collections give no semblance of normal calyces or of a normal kidney pelvis and there is no evidence of their having a ureteric connection. At this time, the lower end of the left ureter can be visualized entering the bladder, and the bladder contour is also well seen. The bladder is asymmetrical, being situated somewhat to the right with its right half situated at a higher level than its left half. None of these studies give any evidence of dye on the right side.

Fig. 1. Forty-five minutes after diodrast showing irregular dye collections on left side only; no evidence of kidney shadow on right.

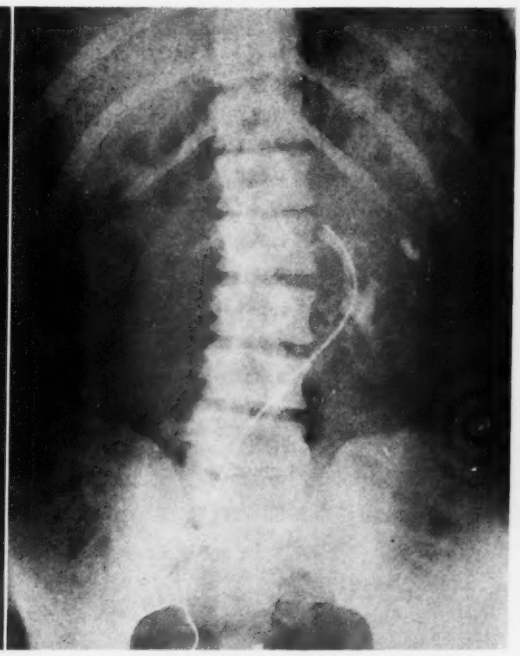

Fig. 2. Catheter introduced through right ureteric orifice showing its course diagonally across to the left renal area.

Retrograde pyelographic studies made on June 15, 1939 (Fig. 2), show the opaque catheter passing up the right ureter and crossing to the left side at the level of the fourth lumbar interspace. The opaque solution injected outlines a very irregular renal pelvis and system of calyces on the left side which correspond to the irregular dye collection noted on the films made forty-five minutes following the intravenous injection.

By correlating the intravenous pyelographic findings with the retrograde findings, it becomes evident that two renal units are present on the left side, each with its own ureter, the one ureter passing down to enter the bladder on the left side; the other, crossing to the right side to enter the bladder on the right side. I understand that only the right ureteric orifice can be located cystoscopically and it is interesting to note that by the intravenous method only the left urinary tract was well defined, because of poor function on the part of the other urinary tract in concentrating the dye.

The patient was discharged on May 20, 1939. The inflammation of the eye had entirely cleared. The pyuria had disappeared and he had no further complaints.

CONCLUSION

Another case of crossed renal ectopia is herewith reported. The diagnosis was established by comparison with retrograde and excretory urography. Physical signs and symptoms in the case presented were negative with the exception of pyuria. The case presented was complicated by a pneumococcis pyelitis. Successful treatment with sulfapyridine is hereby recorded.

New Instruments

WEIGHTED NASAL GASTRODUODENAL TUBE

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TOWARD the end of the nineteenth century, clinicians began to study the possibility of exploring the duodenal contents by way of intubation. Two attempts were made at that time in this direction, one by Hemmeter[1] in 1895 and one by Kuhn[2] in 1898. Both attempts proved impractical as their instruments were crudely constructed.

After experimenting a number of years on various tubes and buckets, Max Einhorn[3] in 1909 developed his duodenal bucket which consisted of a gold-plated, perforated metal capsule tied at the end of a thin rubber tube. This was a truly significant advancement in gastroenterology. Since that time, American gastroenterologists have developed tubes with various types of tips, which I have fully described in a recent article.[4] However, most of these tips were all alike in principle, differing only in their size, shape, weight and number of perforations and none added any decided advantages to Max Einhorn's original tube.

In 1937, I described my new bucketless lead-weighted tube[4] (Fig. 1A) which was a radical departure from previous tubes, in that the bucket was entirely eliminated, and its terminal end encases an elongated drop-shaped lead sinker. (Fig. 1A insert.)

It is of interest to indicate here that the above tubes were introduced by mouth and the element of weight was considered an important factor for the purpose of maintaining the tube along the stomach pathway and accelerating its entrance into the duodenum.

Levin[5] in 1921 advocated the use of a tipless gastroduodenal catheter which he preferred to introduce through the nose. It had a velvet edge at its terminal end exactly like a urethral catheter, No. 14 French in diameter, and had four side openings, oval in shape, at its terminal two inches. While the tube proved highly useful, its disadvantage lay in the fact that the lack of a weighted end resulted in inadequate propulsion into the duodenum.

To overcome this defect, Wilkins[6] in 1928 proposed a nasal mercury-weighted tube which had a mercury holding compartment four and one-half inches long and three-sixteenths inch in diameter at its terminal end with the openings situated above this compartment.

In 1933, Wangensteen[7] proposed his nasal gastroduodenal tube which has the terminal four inches impregnated with lead thereby making it considerably heavier than the Levin tube. This tube contained nine openings in its terminal ten inches and its chief disadvantage lay in the fact that it failed to yield siphonage when the upper openings were above the fluid level.

Recently, I developed a double channel simultaneous gastroduodenal aspirator,[8] the tip of which is lead impregnated for the terminal two and one-half inches. It occurred to me that by substituting the lead encased sinker of the oral tube (Fig. 1A) with a lead impregnated solid rubber tip, I would have an efficient nasal single channel gastrointestinal tube.

The tube (Fig. 1C) is fifty inches in length, No. 14 and 16 French in diameter, semisoft in consistency, flexible and of good resiliency and is made of cacoprene rubber. It terminates in a catheter-like tip which consists of solid lead impregnated rubber

one and three-fourths inches in length and is of the same diameter as the rest of the tube. Two openings slotted in appearance are situated just above the tip one inch apart on opposite sides of the tube. The diameter of the slots is smaller than the lumen of the tube thus preventing clogging of the tube by particles of food.

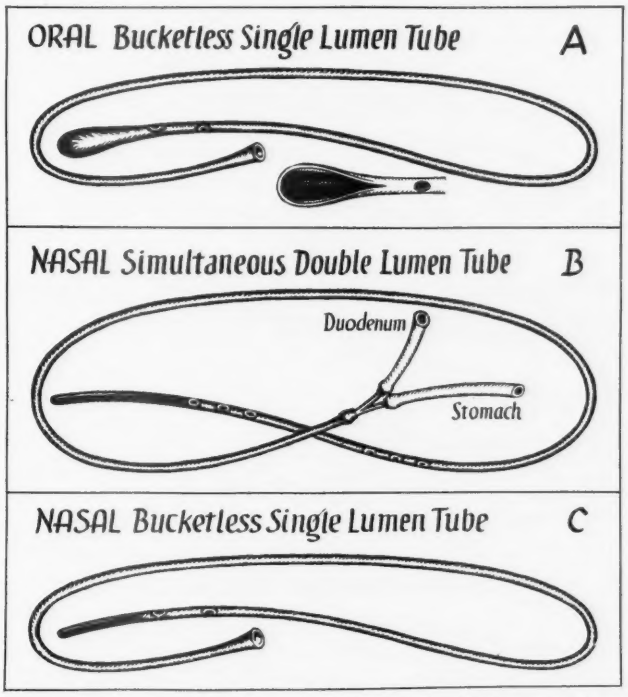

Fig. 1. Author's oral and nasal single and double lumen tubes.

The markings are situated as follows: one-ring mark which represents the distance from the nares to the cardia is placed at nineteen inches; two-ring mark which represents the distance from the nares to the pylorus is placed at thirty inches; and the three-ring mark at thirty-five inches from the tip. It is understood that the physician's judgment should always determine the amount of tubing for each individual and that he should not rely solely on the markings on the tube.

ADVANTAGES

1. The one and three-fourths inch lead impregnated solid rubber, catheter-shaped tip at the terminal end facilitates the introduction and passage of the tube through the nares.

2. The weight of the lead impregnated tip facilitates the passage of the tube through the esophagus, maintains it in its proper position along the stomach pathway and accelerates its entrance into the duodenum.

3. There is less possibility of the lower part of the tube regurgitating into the stomach as the weight of the lead impregnated solid rubber tip anchors the tube in the duodenum.

I wish to express my gratitude to Mr. L. T. Hilborn, president of Clay-Adams Co., for his kind co-operation in the development of the tube.

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A BENT BLADE SCALPEL

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FROM the earliest days of surgery, men have devised instruments to facilitate operative work. The knife or scalpel, as it is called, has always been the most useful and important instrument in the hands of the physician, and various sizes and shapes of blades testify to the uses for which they were devised. In abdominal and gynecological surgery there are many operations that could be made essentially easier if the cutting edge of the knife blade were at a different angle than the commonly accepted straight blade. With this thought in mind, during the last year we have experimented considerably with bent blades.* Blades of various angles from 45 degrees to 60 degrees from the horizontal handle have been used. Blades with both right and left cutting edges have been tried out, but the best results, in our hands, have been obtained with a 60 degree angular blade carrying a circumferential cutting edge.

FIG. 1. A 60 degree angular blade carrying a circumferential cutting edge.

(Fig. 1.) The uses to which this blade can be put are innumerable, and the operations in which we believe it serves its best purposes are the following:

Cholecystectomy—in dissecting the gallbladder and severing the cystic duct; *subtotal hysterectomy*—in reflecting the bladder, separating the fundus from the cervix, and coring out the cervix; in *vaginal cervical amputations*, following either the Sturmdorf or Schroder methods; and in *trachelorrhaphy*.

We are of the opinion that any surgeon, after seeing this blade, would be instantly aware of its advantages in the operative field.

* Rudolph Beaver, Inc., Waltham, Massachusetts.

SPECIAL MONOGRAPH

UROLOGY
IN THE
FEMALE

BY

HOUSTON S. EVERETT, M.D.

Associate in Gynecology, Johns Hopkins University; Gynecologist
in Charge of the Cystoscopic Clinic, Johns Hopkins Hospital

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UROLOGY IN THE FEMALE*

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I. INTRODUCTION

THROUGHOUT most of the nineteenth century efforts to devise some means of adequately examining the interior of the urinary tract engaged the attention of investigators among whom were several prominent gynecologists. Hunner[67] in his chapter on "Diseases of the Bladder and Urethra" in "Gynecology and Abdominal Surgery," by Kelly and Noble, has reviewed the history of this work. Among those whom he mentioned as having devised some type of cystoscope or endoscope applicable to the female were Ségales, of Paris, 1828, Desormeaux, 1852, G. Simon, of Rostock, 1875, Rutenberg, of Vienna, 1876, Grünfeld, of Vienna, 1877, and Skene, of Brooklyn 1878. The instruments devised by these men were of a tubular or conical type closed by a glass window on the vesical end to prevent the escape of water or air which was used to distend the bladder. All of them used water, but Ségales and Rutenberg also used air. Various methods of illumination were used including reflected light from a head-mirror, used by Grünfeld who was also the first to sound the ureters under sight, a metal sound being passed through the urethra beside the cystoscope. Simon had previously passed metal catheters into the ureters guided by palpation with the index finger, after having incised the meatus and dilated the urethra sufficiently to admit the finger into the bladder. Pawlik of Prague devised a more practical and less mutilating procedure of guiding a metal catheter into the ureter by means of vaginal palpation. Nitze in 1889 published his "Lehrbuche der Kystoskopie" in which he described his work, begun in 1886, which led to the development of the forerunner of all modern indirect cystoscopes, which make use of

* In the preparation of this article several helpful criticisms and suggestions have been contributed by Dr. Guy L. Hunner and Dr. Richard W. TeLinde. Permission for reproduction of illustrations has been kindly granted by Dr. Howard A. Kelly, Dr. Curtis F. Burnam, Dr. Guy L. Hunner, Dr. George Gray Ward, Dr. Samuel H. Geist, Dr. J. Mason Hundley, Dr. Erle Henricksen and Dr. Laman A. Gray. The author acknowledges these courtesies with grateful appreciation.

the principles of a light within the viscus and a series of lenses to magnify and bring the field to be examined into view.

Howard A. Kelly early in his career recognized the great importance of diseases of the urinary tract as related to gynecology. The two opening paragraphs from his paper published in 1888 on "Palpation of the Ureters in the Female"[112] are so prophetic of subsequent lines of development that they are worthy of direct quotation:

"By palpation of the ureters the gynecologist has at his command a new and valuable adjuvant in the correct diagnosis of renal and bladder diseases and their sequelae, as well as the possibility of recognizing intrinsic diseases of the ureters hitherto only discovered on the postmortem table. Such is the specialization of specialties, that I have been asked by surgeons if the ureters are prone to disease of any sort or variety. It is but necessary to consult the works of Rayer, Cruveilhier, and others on renal diseases, and especially the plates of the former, to recognize at once the extent to which the ureters are often associated with the kidneys, participating in processes of inflammation, ulceration, and tuberculosis. Here invariably the ureteral disease is secondary, descending, and the condition of the ureters discovered by a vaginal examination may be the first clear point in determining the nature of the disease above, and the only possible means, short of operation, of determining on which side the disease exists. Again, inflammatory diseases of the bladder, particularly gonorrheal, often have a fatal tendency to travel upward, resulting in pyelitis and pyelonephritis. Here the affection of the ureter invariably precedes that of its pelvis and the kidney, and may at once put a careful observer on his guard as to possible consequences, even of an apparently mild inflammation. Calculus resting in the pelvis of the kidney or lodged in the ureter, occasions an inflammatory condition of the whole of the tract below, easily distinguished by palpation.

"When we recall the immense quantities of excrement discharged daily through these delicate tubes, from two organs absolutely essential to life, one or other of which may be diseased, or both in different degrees, and associate with this the anatomical relation of the pelvic portion of the ureter in the female, placing it within easy reach of the examining finger, we see at once the importance of a careful routine consideration of their condition and function in every case coming under observation. It is but necessary to bear in mind the cases of hydro-nephrosis which have been caused by pressure of uterine tumors, ovarian tumors, retroflexion, and even prolapsus uteri, and the constriction of parametric scars, caused also in one case by a retroperitoneal sarcoma observed by the writer, and to remember the possible effects of pressure by the gravid uterus, as well as the large number of cases of carcinoma uteri which die of uraemic coma, from involvement and obstruction of the ureters, not to cite cases in which

the ureters have been tied in enucleating the cancerous uterus per vaginam, as communicated to me by Dr. H. S. Coe, and observed by others, as well as cases in which a ureter has been cut in opening a pelvic abscess, to realize the clinical importance of ureteral pathology. I may also here mention the fatal results which have followed the neglect of Dr. Emmet's precaution, in the operation of vesico-vaginal fistula, of rolling out the edges and hunting for the ureteral orifices, a neglect which has in many instances resulted in death and in more in a failure in the operation. This brief statement of the important facts serves to show how extended a field is here open for the gynecologist, connecting him often with practical medicine, just as the abdominal surgeon of today closely links his work with that of the general surgeon. In fact, with a more careful study of bladder trouble, now the bête noir of gynecology, with a differentiation of bladder and ureteral diseases up to this time impossible, and with an association of a careful study of renal diseases as connected with or to be disassociated from the last, a new realm seems to be opening to the scientific gynecologist."

This paper as might be surmised from its title, although it referred to inspection of the ureteral orifices and their catheterization through a vaginal cystotomy wound as suggested by Emmet, and to the methods of catheterization used by Simon and Pawlik which have already been mentioned, was devoted largely to the technic of palpation of the ureters through the vagina and the knowledge to be gained therefrom. A man of Dr. Kelly's energy and ingenuity, however, was not to be satisfied long with the information that he could gain by palpation of the ureters alone, nor with the crude methods then available for ureteral catheterization. In 1893, he delivered an address before the Washington Obstetrical and Gynecological Society entitled "The Direct Examination of the Female Bladder with Elevated Pelvis—The Catheterization of the Ureters under Direct Inspection, with and without Elevation of the Pelvis."[113] In this the use of a simple open tubular speculum, through which the bladder could be distended with air by means of posture, was described. Most of the instruments and technic of what is known today as the "Kelly open air" method of cystoscopy were also described. Three positions were suggested for obtaining distention of the bladder by air; the dorsal position with hips elevated, the Sims position, and the knee chest position. The last named soon became recognized as superior to the others in most instances.

As an outgrowth of this pioneer work by Dr. Kelly, examination of the urinary tract and treatment of its diseases became an integral part of the work in his gynecologic department at the Johns Hopkins

Hospital. Gradually a female cystoscopic clinic for examination and treatment of both hospitalized and out-patients was established as a definite unit of the gynecologic service. Dr. Guy L. Hunner, who early in his career became especially interested in this phase of gynecologic practice, has been the guiding influence in this clinic to the present date. Through his careful and painstaking observations he has contributed much to the speciality of urology, not only as applied to gynecology, but to general urology as well. Many of his published contributions will be referred to later, but above them should be placed the example that he unceasingly has set before his understudies of untiring patience, careful attention to detail and faithful labor in the interest of his patients. As a result of the examples and teachings first of Kelly and later of Hunner, there have been trained and spread about this country a group of gynecologists who have come to look upon their specialty as one dealing with the genital and urinary tracts in the female. This is, it would seem, the only logical development of this specialty. These two systems of organs are so closely related anatomically and pathologically that it is impossible to examine and treat the one without a thorough knowledge of the other also. To emphasize this a direct quotation from Hunner[78] is to the point: "Can there be any more reason for demanding that the specialist in male genital diseases should be a first class female urologist than there would be in expecting a gynecologist to do justice to male patients suffering from urinary tract disorders? One rarely sees women patients with urological complaints in which there does not enter some question in gynecology. One cannot be a gynecologist and do his patients justice without constantly weighing the finer points in urology and having the facilities at hand to decide whether the patients' chief complaints arise in the genital or in the urinary tract."

In the following pages an attempt will be made to develop this thesis by dealing largely with structural and pathologic entities in the urinary tract which are peculiar to the female. In order to do this the following outline will be developed: (1) The anatomic relationships between the urinary and genital tracts will be briefly described. (2) Diseases of the urethra which differs strikingly in the female from the same organ in the male will be treated in full. (3) Conditions resulting from the traumas of parturition and from gynecologic therapy will be emphasized. (4) Disorders arising in the urinary tract resulting from lesions of the genitalia will be discussed. (5) Urinary

tract infections complicating pregnancy and the puerperium will be fully treated.

Such conditions as pyelitis and pyelonephritis not associated with

FIG. 1. Median longitudinal section through the female pelvis showing the anatomical relationships, particularly those of the bladder and urethra to the uterus and vagina. (From Kelly, Howard A. Operative Gynecology. New York, 1898. D. Appleton & Co.)

pregnancy, urinary lithiasis, tuberculosis and neoplasms, which are common to both sexes will be touched upon sparingly, and then only to point out certain etiologic factors that may be peculiar to the female.

II. ANATOMY

No attempt will be made here to describe completely the anatomy of the urinary tract. Those desiring to review this subject may be referred to "Diseases of the Kidneys, Ureters, and Bladder," by Kelly and Burnam.[121] In order to stress the close relationship between the urinary organs and those of the genital tract, however, a brief

review of several important points will be set forth. The accompanying illustrations serve to bring out these points more vividly than can be done by description. Figure 1 shows a median longitudinal section through the female pelvis. From this illustration the close relationship between the urethra and bladder on the one hand and the vagina and uterus on the other can be readily seen. The urethrovesicovaginal septum is made up of mucosal, submucosal and muscular coats of the urethra and trigone and base of the bladder, and of the pubocervical fascia and vaginal mucosa. The pubocervical fascia, which is the anterior portion of the vaginal reflexion of the internal fascial covering of the levator ani muscle, extends from the inner surfaces of the pubic rami upward and posteriorly to be attached to and reflected downward on the anterior surface of the cervix. The strong lateral portions of this fascia are often called the pillars of the bladder. It is a thinning out of the central portion of this fascia, often together with a separation of it downward from the cervix, that results in the formation of a cystocele. When the thinning out extends anteriorly beneath the urethra, a urethrocele is formed and frequently the normal support of the urethral sphincters are lost and varying degrees of incontinence result.

Figure 2 shows the arrangement of the muscular coats of the bladder and urethra and the urethral sphincter mechanism.

Figure 3 shows the position of the kidneys, ureters and bladder with reference to the structures in the posterior abdomen and in the pelvis. From this illustration it can be seen readily how the ureters as they cross the pelvic brim are subject to compression by pelvic tumors or the pregnant uterus. The close proximity of the ureters to the ovarian vessels as they approach the ovaries in the infundibulopelvic ligaments is also apparent.

Figure 4 shows the relationships between the uterus and uterine vessels on the one hand and the bladder and lower ureters on the other.

III. THE URETHRA

During recent years it has been the frequent lament of several prominent urologists (W. E. Stevens, John R. Caulk, A. I. Folsom, and others) that the female urethra is a much neglected organ. It is indeed true that in most textbooks and systems the space allotted to diseases of this organ is relatively small as compared with that devoted to the male urethra and to other organs of the urinary tract.

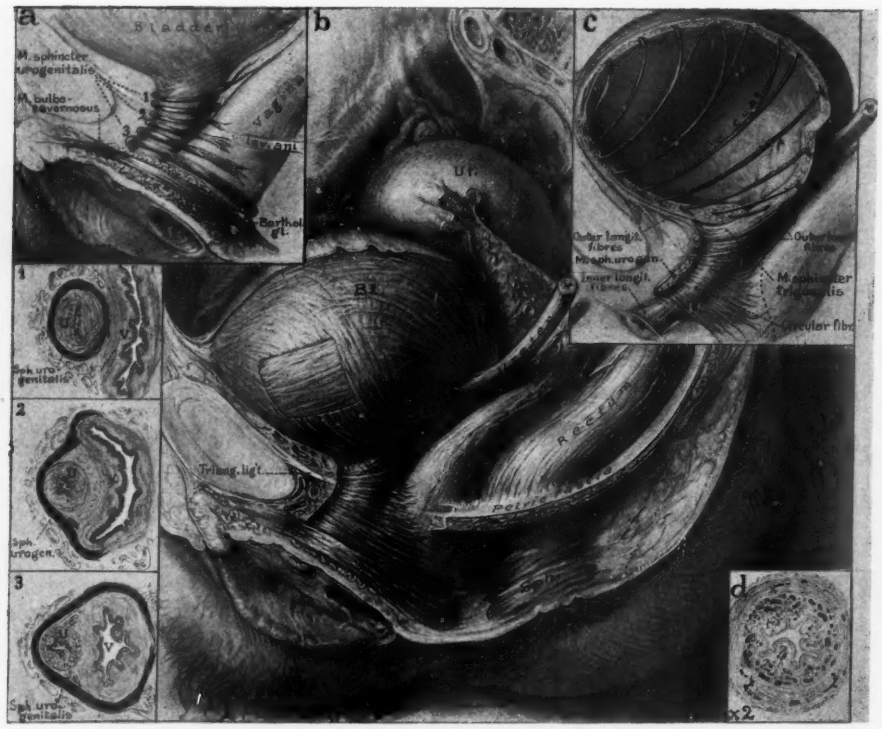


FIG. 2. Musculature of the bladder and urethra. *a*, diagram showing direction and disposition of muscle bundles composing the voluntary sphincter of the urethra (sphincter urogenitalis); the uppermost bundles (1) surround the urethra, the terminal fibers passing in an upward direction in the vesicovaginal septum. Other fibers form a complete ring muscle (see also little Figure (1) below). The middle bundles (2) surround the urethra in front, passing over into the vagina and becoming inserted in its lateral musculature. The lowermost bundles (3) surround both the urethra and the vagina, terminating in the rectovaginal septum (see little Figure 3 below). The urogenital sphincter terminates at the junction of the external and middle portion of the urethra, the lowermost portion being embraced by the M. bulbo cavernosus with the erectile tissue of the bulbi vestibuli intervening.

b, dissection of the muscle coats of the bladder and urethra. A little square has been cut in the outer longitudinal layer of the bladder muscle, exposing the fibers of the middle circular coat. The voluntary sphincter of the urethra is shown in its entirety. A portion of the pelvic fascia and the triangular ligament is removed in order to expose the urethra.

c, diagrammatic representation of the involuntary sphincter of the urethra, the M. sphincter trigonalis. As shown in the Figure, the fibers of this sphincter have their origin in the muscle bundles of the trigonum, the fibers passing obliquely downward and forward and surrounding the internal urethral orifice in an oblique direction. The lower circular fibers of the urethral sphincter are inserted in the lateral vaginal wall. The fibers of the inner longitudinal muscle coat of the lower urethra are relatively strong and taper as they end, only a few reaching as far as the bladder.

d, injection of the erectile tissue of the urethral submucosa. (Figure and legend from Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

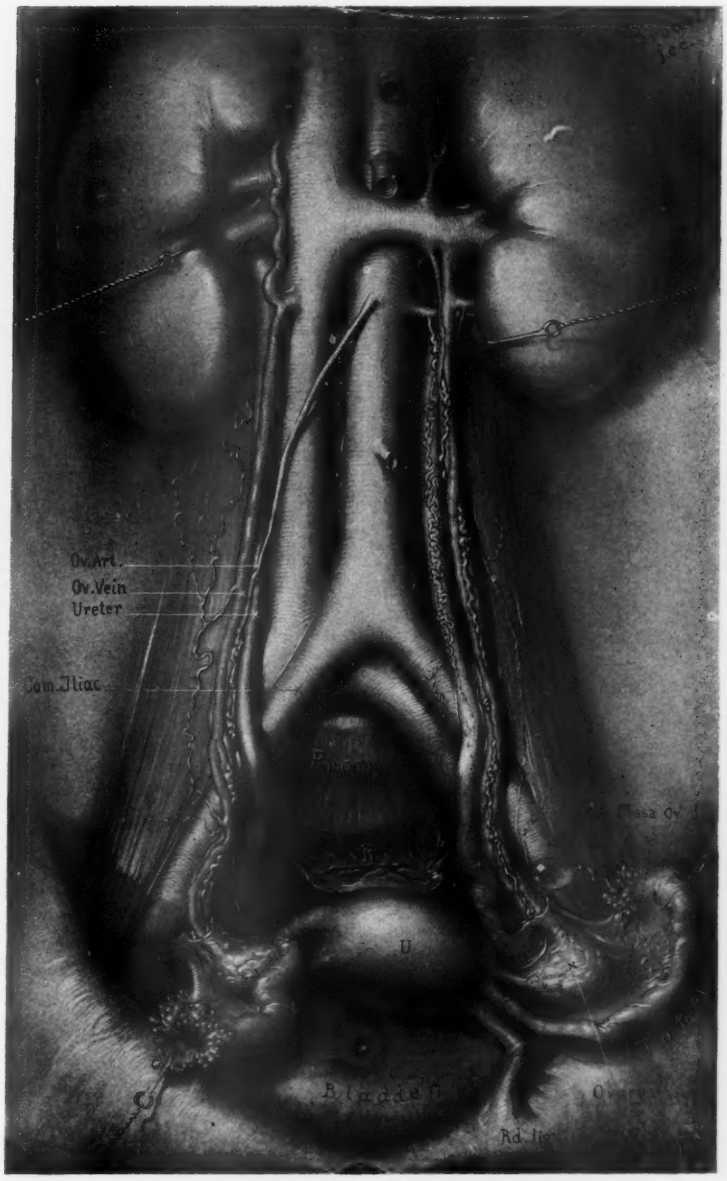


FIG. 3. Showing the relation of the kidneys and ureters to the anatomical structures in the posterior abdomen and in the pelvis. (From Kelly. Operative Gynecology. New York, 1898. D. Appleton & Co.)

If one reviews the recent urologic literature, however, there are to be found quite a large number of contributions dealing with this subject. Among these contributions, however, are found so many and such

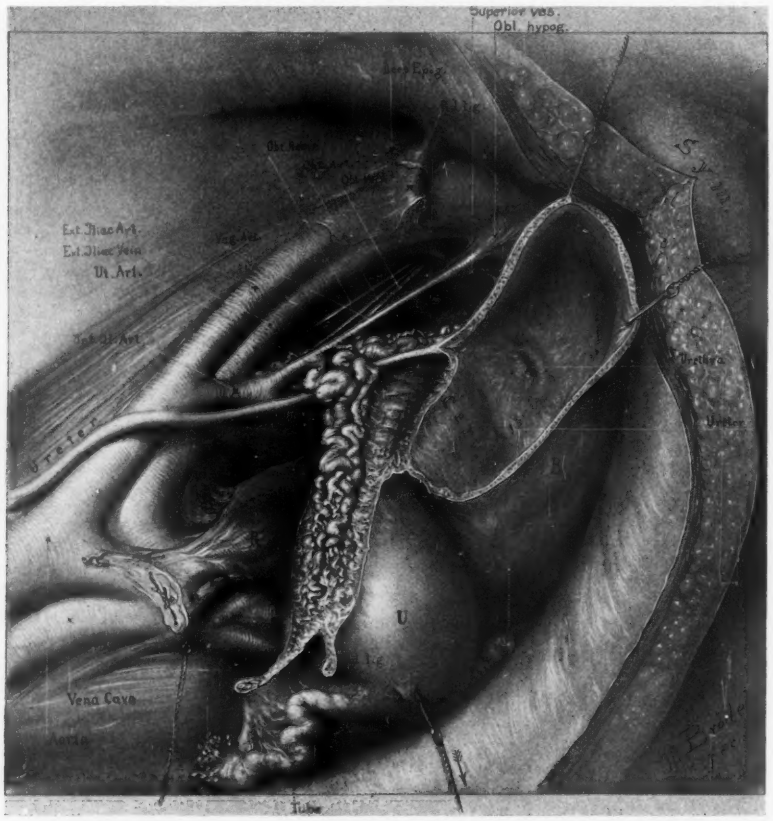


FIG. 4. Showing the anatomical relations of the bladder and left ureter to the cervix uteri and to the uterine vessels. (From Kelly. Operative Gynecology. New York, 1898. D. Appleton & Co.)

varied opinions as to what lesions are of most frequent occurrence and of chief importance, that confusion soon results unless the reader possesses a sound background of personal experience, in the light of which he can weigh these conflicting opinions. In the following pages devoted to the subject of the female urethra, an attempt will be made to review and analyze some of this literature in the light of experience derived from the urologic handling of female patients exclusively.

1. *Anatomy.* The female urethra is a tubular structure, the length of which is variously stated by different authors as being from 2.5 to 4 cm. My own measurements recently made on a series of

twenty women have disclosed lengths from 3 to 5.5 cm. with the majority being between 4 and 4.5 cm. and the average 4.1 cm. The normal adult urethra in most instances is capable of easy dilatation to a diameter of 9 or 10 mm., although some are found apparently perfectly normal in which dilatation beyond 8 or even 7 mm. will cause splitting of the mucous membrane of the meatus which is usually the narrowest part of the canal.

The internal or vesical orifice of the urethra lies about 2 to 2.5 cm. back of the midportion of the symphysis pubis, and from here the tube extends downward and curves slightly forward to the external meatus which opens in the midst of the vestibule of the vagina about 2 cm. posterior to the base of the clitoris. In this position it lies directly anterior to the lower vagina and penetrates the urogenital trigone. Its external portion is usually lined by stratified squamous epithelium which merges posteriorly into the transitional type of epithelium, characteristic of the lining of the bladder, ureters and renal pelves. The point of change between these two types of epithelium, however, is variable, in some the transitional epithelium extending almost to the meatus.

The muscular coats are continuous with those of the bladder, and consist of an inner and outer longitudinal layer with a circular layer between them. The circular layer constitutes the involuntary sphincter which according to William T. Kennedy[123] is most efficient around the inner third of the urethra. The voluntary sphincter according to the same author is around the middle third and is derived from the urogenital trigone.

The subject of urethral or paraurethral glands is one concerning which there is a striking lack of unanimity of opinion. The glands of Skene, which are compound racemose glands whose ducts open into the floor of the urethra or either side just within the meatus, are definite structures the existence of which is not questioned. Hunner[67] states that there are many glands varying from simple tubular recesses or inversion of the mucous membrane above to the more complex glands of Skene below. Folsom[46] is strongly convinced of the presence of glands in the upper urethra and assigns to them an important rôle in chronic nonspecific urethritis. F. P. Johnson[104] on the other hand, who has made careful embryologic studies, finds that glands corresponding to that portion of the prostate which lies between the vesical orifice and the orifice of the prostatic utricle, develop early in the female embryo, but later regress and are repre-

sented only by shallow crypts mostly in the lower urethra in the term infant and adult. Cabot and Shoemaker[11] who have made very careful anatomic studies on autopsy material conclude that except for Skene's glands there are no true glands present in the urethra. They did, however, describe mucosal crypts, small cysts and cell nests in the mucosa and submucosa which they believe are derived from von Brunn's cell nests. Contrary to Folsom's belief they considered these of very little clinical significance.

2. *Congenital Anomalies.* An abnormal narrowing of the urethral meatus in the absence of other evidence of disease is encountered not infrequently. Unless this condition is to be considered as a congenital stricture of the meatus, as it is by William E. Stevens,[192,194] the general statement that congenital anomalies of the female urethra are extremely rare may be accepted without further reservation. Aside from the above mentioned narrowing of the meatus, hypospadias of varying degree is probably the most frequently occurring type of anomaly. Indeed it is not uncommon to find the urethral meatus opening closer to or slightly within the vaginal orifice. This type of deformity usually produces no symptoms except perhaps slight spilling of the urine into the vagina resulting in dribbling, and as a rule no treatment is required. In severer degrees of hypospadias the posterior wall of the urethra may be entirely lacking, so that the bladder opens directly into the vagina. Such cases require plastic operations designed for the construction of an urethra. In cases of adrenal virilism the vagina, which is very small and poorly developed, joins with the urethra 1 cm. or more above the meatus so that there is only one orifice for the two canals. This might be considered a type of hypospadias, but it usually causes no inconvenience so far as the urinary tract is concerned; and in view of the generally underdeveloped condition of the vagina the defect should probably be considered as vaginal rather than urethral.

Davis[33] collected seventy-nine cases of epispadias in the female from the literature prior to 1928. The meatus may open just above or below the clitoris. In severer types there is complete absence of the anterior urethral wall associated with nonunion of the pubic bones and exstrophy of the bladder. Such a condition of course results in complete urinary incontinence and can be treated satisfactorily only by diversion of the urinary stream.

Cases of complete or incomplete double urethra have been reported but are extremely rare, only four such cases having been

collected by Stevens.[194] Unless complicated by some other condition there should be no symptoms, as was the case of a patient reported by Dannreuther,[30] who complained of frequency and dysuria which were entirely relieved after removal of a caruncle found at one meatus of a complete double urethra.

Absence and atresia of the urethra have been reported but again are extremely rare. Stevens[194] has collected seven such cases from the literature. In three of these there was direct communication between the bladder and vagina with total incontinence, in three others, all newborn infants, there was no outlet for the urine, while the seventh case, a woman of forty-two had always urinated through the umbilicus.

Stevens[194] also has collected from the literature since 1552, fourteen cases of obstruction of the female urethra by diaphragms or valves. In eleven of these the obstruction was complete. The obstruction was at the meatus in ten, near the bladder in three and in the middle third in one. Five infants with complete obstruction were stillborn, and one died eight days after birth, while four were cured by perforation of the obstruction. In three patients with complete obstruction the urine escaped through the urachus.

3. *Inflammations.* Inflammatory lesions of the urethra occur frequently. They may be divided into acute and chronic urethritis which are common, and certain rarer conditions such as chancre, chancroid, granuloma inguinale and lymphopathea venereum.

Acute urethritis in women is due in most instances to gonorrheal infection, though occasionally an acute inflammation may result from invasion by other cocci or the colon bacillus. Trauma or chemical irritation may predispose to such a nonspecific inflammatory process. Stevens[192] states that in the examination of 1,064 women infected with gonorrhea, the specific organisms were found in the urethral discharge in 32 per cent. The disease in most of these women, however, was in a chronic stage. In the author's experience during the acute stages of gonorrheal cervicitis, the organisms can be found in urethral smears in practically every case, and not infrequently symptoms of burning on urination associated with frequency and urgency may appear before there is a profuse vaginal discharge. Thick pus can be expressed from the meatus by massaging the urethra through the vagina, and the gonoccocci can be identified in smears of this pus, often much more readily than in the cervical discharge. The slide from the cervix is more apt to be confusing because

of the presence of many bacteria of other varieties. Skene's glands are often involved and may go on to abscess formation in which case incision and drainage is required. Aside from this, however, active manipulative treatment during the acute stages is best avoided. To render the patient more comfortable fluids should be forced to reduce the concentration of the urine, which should also be rendered alkaline by the adequate administration of sodium bicarbonate. Warm sitz baths and the generous use of sedatives are useful in those patients suffering acute distress. These measures are applicable also to those cases of nonspecific origin. The use of sulfanilamide or its related compounds for the cases of gonorrheal origin is the treatment of choice. Sulfanilamide or sulfathiazole, 4 to 6 gm. daily for a period of one week will usually suffice to effect a cure, but in our experience it is usually wise to continue the administration of small doses from one to two weeks longer to insure against recurrence. In the cases of nonspecific origin the acute inflammation will tend to subside with the above mentioned palliative measures alone, if the inciting cause is removed.

Chronic urethritis has been considered in the past to have resulted most frequently from a gonorrheal infection, though several other types have been described and emphasized. With the increasingly widespread use of sulfanilamide and its related compounds during the acute stages of gonorrheal infections, the time will probably soon arrive, if indeed it has not done so already, when the above statement can no longer be said to be true. There probably always will be some patients, however, who, because of neglect in the acute stages, refractiveness to sulfanilamide therapy, or inability to complete an adequate course of such therapy because of toxic reactions, may pass from the acute into the chronic phases of the disease. A discussion of this phase of gonorrheal urethritis, therefore, is still appropriate and to the point.

The symptoms of chronic urethritis are apt to be the same as those of the acute condition but of milder degree. There is frequency and urgency with a stinging or burning sensation on voiding, and a constant dull pain, which at times may be sticking or stabbing in character, and may be referred to the suprapubic region, the vagina, or even higher in the abdomen along the course of the ureters. This tendency for pain resulting from chronic urethritis to be referred to other regions has often led to mistakes in diagnosis and unnecessary gynecologic operations or treatment. Terminal hematuria may also be present.

On examination the urethra will be found to be thickened and somewhat tender on vaginal palpation. If the disease has originated as a gonorrheal process, there may be evidence of a chronic cervicitis and chronic Bartholinadenitis. Skene's glands will usually be involved, and can be felt as pea-sized nodules on each side of and just posterior to the urethral meatus. In the chronic cases there may be little or no pus which can be expressed from the urethra and it may be quite impossible to identify the specific organisms. In such cases one must depend upon a history of an acute infection and the above mentioned findings for the etiologic basis of the condition. If there is an associated cystitis or pyelitis, the catheterized urine will contain pus, but more frequently this is not the case. Stevens,[192] Hunner,[68,77] and others have stressed the importance of stricture as an associated lesion requiring adequate treatment, but the nature of these strictures is not the subject of complete agreement among urologists. This subject will be discussed more fully in later paragraphs. For the moment suffice it to say that the urethra usually can be dilated less readily than in the normal state. After dilatation with Hegar dilators, a Kelly cystoscope of appropriate size should be introduced and gradually withdrawn, observing the lining of the urethra as it folds over the end of the instrument. In the normal state the longitudinal striae of the mucosa will appear as alternate light and deep pink rays extending from the center to the periphery of the field. When chronic inflammation is present, this appearance is replaced by one of diffuse reddening, and the mucous membrane appears rough and granular and tends to bleed easily. Some authors, notably Folsom,[46] Ormand,[165] Spence,[189,190] and Caulk[12,13,14] have stressed the proliferative tendency of lesions in the posterior urethra, and have described in addition to granulations, cystic formations in the mucosa and even polypi and papillomas: Folsom[46] in particular and also Caulk[12,13,14] have emphasized the importance of glands in the posterior urethra in the production of this type of lesion, but Cabot and Shoemaker,[11] after making very careful anatomic studies, came to the conclusion that there are no glands worthy of the name or capable of being clinically significant in this region, and Caulk[13] himself, in describing the histology of material removed from the vesical neck by the cautery punch, mentions no glands.

The etiology of many cases of nongonorrheal chronic urethritis is somewhat obscure. Ormond[165] found the condition at all ages, but more common in the middle age of life and in married women.

Spence[189,190] has found it frequently in children. Such factors as trauma of childbirth, irritation from coitus and masturbation, and associated lesions of the genital organs or rectum have all been mentioned as etiologic factors. Ormond[165] lists the following conditions as found in his series: anemia 52.5 per cent, gastrointestinal disturbances 48.2 per cent, focal infection 47.3 per cent, pelvic abnormalities 43 per cent, constipation 26.8 per cent, low basal metabolic rate 27.9 per cent and rectal abnormalities 19.4 per cent. He thinks that any of these may act as the etiologic factor in the individual case.

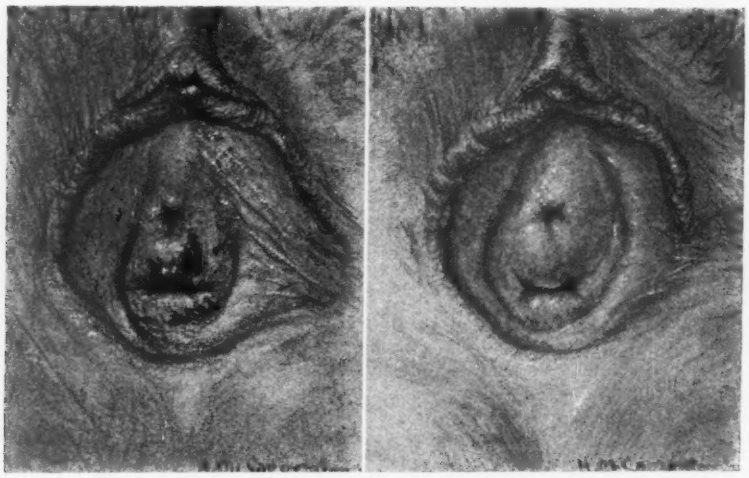
Hunner[68,77,91] has emphasized the rôle of distant foci of infection, particularly in tonsils, at the roots of teeth and in paranasal sinuses. He believes that in dealing with the obstinate chronic cases which resist all the usual methods of treatment, more of them are found to belong in the focal infection group than in that due to gonorrhea. "These focal infection urethritides are not accompanied by gross discharge. They occur in patients of any age. The catheterized urine is normal unless the patient has synchronous inflammation and infection in the tract above the urethra. Even in the very chronic gonorrheal case the usual methods of treatment soon result satisfactorily, not so in the focal infection case. In these, with or without treatment, we may have brief intervals of improvement in symptoms, but a cure is not obtained until the causative focus of infection is removed. In the case of a child, or in an adult, when one can exclude gonorrhea as a probable cause, it saves much time, useless painful treatment, and expense, if one locates a distant focus of infection and has this eradicated. It is one of the miracles of medicine to make the correct diagnosis in one of these cases and see the patient recover without further resort to urologic therapeutics. The victim may have suffered many years of discomfort in the pelvis and lower abdomen, and all varieties of bladder symptoms even to spells of total incontinence, and she may have had years of painful treatments aimed at the local lesions; and then, with the discovery and eradication of the causative focal infection, the symptoms cease within a few weeks, and urethroscopy shows that the formerly granular mucosa has returned to normal.

"One learns by experience to suspect a distant focal infection as the etiologic factor in any urinary tract lesion, whose symptoms appear only periodically, the intervals being marked by freedom from symptoms."

The treatment of the gonorrheal cases consists first and primarily of clearing up of persistent foci such as the cervix, Bartholin's glands and especially Skene's glands. If gonococci can be found in any of the discharges, a course of sulfanilamide therapy should be tried, though it is well recognized that the drug is much less apt to be effective in the chronic than in the acute stages of such an infection. A chronically infected cervix should be cauterized or subjected to some such procedure as the Sturmdorf operation, and palpable or cystic Bartholin's glands should be removed. The ducts of Skene's glands may be exposed by retraction of the external urethral orifice with hairpins, and using a fine hypodermic needle as a cannula, they may be aspirated and instilled with some antiseptic solution as suggested by Kelly. The eradication of infection in these foci, however, is usually accomplished more quickly and completely by widely incising the glands from the vestibular side, and thoroughly cauterizing the lining with pure carbolic acid or silver nitrate, or even with the actual cautery or fulgurating electrode. After such foci of infection have been eradicated the urethra should be dilated once a week attempting to achieve and maintain an eventual dilatation with a No. 10 Hegar dilator or larger. After each dilatation the urethral mucous membrane should be thoroughly swabbed with silver nitrate solution, using at first 3 per cent and gradually increasing to 10 per cent. Some authors suggest using solutions as strong as 20 per cent, and while these may be more efficient in the nonspecific cases with marked granulations and proliferative formations, in our experience they are usually not required to effect a cure in the case of gonorrheal origin. If the above methods are faithfully employed in the gonorrheal cases, a cure is usually effected within a few weeks, and failure in this usually indicates that the eradication of infection in all nearby foci has not been satisfactorily accomplished, or else that the case is one of nonspecific origin.

The treatment of chronic urethritis of nongonorrheal origin frequently offers a more difficult task than is presented by the gonorrheal cases. While urethral dilatations and the applications of silver nitrate will often given temporary relief, the symptoms are very apt to recur when treatment is stopped, unless all contributory factors such as distant foci of infection and lesions in the nearby genital organs have been discovered and eliminated. In the cases with granulations and polypoid formations such as are stressed by Folsom,[46] Ormond,[165] Spence[189] and others, stronger silver nitrate,

20 per cent solution, or diathermy fulguration have been found more effective. In attacking the problem of those patients whose symptoms often fail to respond to apparently adequate treatment, the



a *b*

FIG. 5. The appearance of the vestibule of the vagina and the urethral meatus in a postmenopausal patient (*a*) before and (*b*) after treatment with estrogenic vaginal suppositories. The patient complained of frequency and dysuria for which no other cause could be found and which were relieved by the treatment.

fact should be kept constantly in mind that lesions of the urinary tract particularly those due to focal infection are often multiple. The association of chronic trigonitis with chronic urethritis is widely recognized, and Hunner has found "elusive ulcer" and chronic ureteritis or ureteral stricture often associated with urethral disease. Stevens[194] found that 46 per cent of his patients with urethral stricture and chronic urethritis also had ureteral stricture. The author has long felt and emphasized to students that the persistence of symptoms ordinarily thought of as originating in the bladder or urethra, even though the bladder urine may be normal, demands a complete investigation of the whole urinary tract. Such investigations will often disclose trouble above the bladder which when eliminated will result in symptomatic relief where other measures have failed; more important still, if such lesions had remained undiscovered and untreated, serious renal damage might have resulted.

During the past few years there has come under my observation a small group of patients presenting severe symptoms but mild signs of chronic urethritis, in whom all of the above mentioned etiologic

factors could be satisfactorily excluded. These patients have all been past the menopause and the onset of symptoms in each had been practically coincidental with the menopause. In several of them treatment along the lines described above were carried out over considerable periods of time without any appreciable permanent symptomatic benefit. On examination these patients have all showed signs of postmenopausal thinning and atrophy of the vaginal mucous membrane with splotchy areas of reddening, and this splotchy reddening has extended onto the vestibule and surrounded the urethral meatus which has appeared puffy and edematous. The administration of local estrogenic therapy in the form of vaginal suppositories of amniotin (Squibb) 2000 International Units each, one of which is inserted into the vagina nightly, has usually given relief in from seven to ten days. Treatment may then be discontinued but must be repeated at intervals of six to eight weeks to maintain relief. After such a course of therapy the reddening is found to have disappeared and the vestibular and urethral mucous membrane presents its normal healthy appearance. (Fig. 5.)

Chancre involving the urethra as with most of the female genitalia probably occurs much more frequently than it is seen. Because of the usual lack of subjective symptoms from this lesion it may run its course unobserved. When discovered antisyphilitic therapy should be instituted at once. Chancroid and granuloma inguinale are important chiefly because of the dense scarring that they leave on healing, which may result in dense strictures of small caliber which require dilatation over a long period of time. Recently it has been found that the healing of chancroidal lesions may be greatly hastened by the administration of sulfanilamide or sulfathiazole in about the same manner as they are used for gonorrhea.

There is a form of lymphopathea venereum which seems to attack primarily the urethra, and which has recently been thoroughly described by Gray.[54] The process is one of slow ulceration, which may be arrested at any stage with resulting stricture, or may progress to complete destruction of the posterior wall of the urethra up to the vesical neck, with a result simulating complete hypospadias and leading to complete urinary incontinence. (Fig. 6.) Other parts of the vagina, the vulva and the rectum are usually also involved. The appearance of the lesion is usually sufficient for diagnosis which can be confirmed by the specific skin reaction described by Frei.[47] Treatment during the progressive phase of the disease has been unsatisfac-

tory in the past, but recently some benefit has been ascribed to treatment with sulfanilamide. Eventually healing takes place spontaneously probably as a result of the acquiring of immunity on the

a *b*

FIG. 6. *a* and *b*, two cases with destructive ulcerative lesions of the urethra due to lymphopathea venereum. (From Gray, L. A. *Surg., Gynec. & Obst.*, 62: 745, 1936.)

part of the patient. Treatment of defects resulting from the process require plastic surgical reconstruction of the urethra which will be described in connection with the treatment of urinary incontinence in general.

4. *Stricture.* That a wide divergence of opinion exists in regard to the incidence of stricture of the female urethra may be surmised from the following quotations both taken from "Practice of Surgery" by Dean Lewis: "Stricture of the female urethra is a very rare condition and usually occurs at or very near the urinary meatus," TeLinde:[198] and "It is only within a comparatively recent period that urethral strictures have been accorded the recognition they deserve as important etiologic factors in genitourinary tract disturbances in women and female children," Stevens.[193] Such diversity of opinion is probably best explained on the basis of difference in conception of what really constitutes a stricture. If we limit the term to mean such small caliber strictures as frequently occur in the male as a result of chronic gonorrhea and paraurethral abscesses and which are sufficiently tight to result in residual urine or sometimes even complete retention, then TeLinde's statement is undoubtedly true. In a large active clinic devoted entirely to females we probably do not see more than a half dozen such strictures in the course of a year, and these are usually the result of some such lesion as lymphopathea venereum or

granuloma inguinale. On the other hand, Hunner, who was for many years in charge of this same clinic, has repeatedly emphasized the frequency of a diffuse narrowing and infiltration of the urethra in association with chronic urethritis, and has emphasized the importance of thorough and repeated dilatations as a part of the treatment of these patients. Using Hegar dilators usually both for calibration and dilatation of the urethra, Hunner and those of us trained under him have been more impressed with the frequency of diffuse thickening and narrowing throughout the entire length of the urethra than we have with annular strictures. We have, however, frequently noted as has been emphasized by Stevens that, even in such diffusely infiltrated urethras, the region of the meatus seems to be the narrowest and most difficult to dilate, while in other patients a definite increase in resistance will be noted just before the dilator passes through the internal sphincter to enter the bladder. At times there is evidence of multiple areas of annular narrowing.

Most of the authors mentioned above as contributing to the subject of chronic urethritis, Folsom,[46] Ormond,[165] Spence,[189] Côte and Smith,[23] Hunner,[68,77] and Stevens,[192,193,194] have emphasized the importance of thorough and repeated dilatations of the urethra as a part of the routine treatment. Using olive tipped bougies to detect and locate strictures, in a number of contributions William E. Stevens[191–194] has emphasized their frequency and stressed their importance, not only as a contributing factor in chronic urethritis, but in other conditions of the urinary tract as well. He found 328 urethral lesions in 425 patients[191] with urinary disturbances, and 458 strictures in 1,227 patients examined.[194] In 85.6 per cent of these the stricture was at the external meatus and he believes that many of these may have been congenital, but that strictures in the canal and at or near the internal urethral orifice are nearly always acquired. He found the average size of the urethra in 118 adult women who had never suffered from urinary symptoms to be 26 French, while the average size in 174 strictures was 21.45 French. In another article[192] he states that acquired strictures of inflammatory origin are most often due to gonorrhea or ulceration and usually occur at or just within the urinary meatus, while strictures due to trauma are found both at the meatus and in the lumen of the canal and are usually the result of childbirth or operative procedures.

The symptoms of stricture as observed by Stevens[192,194] in order of their frequency of occurrence are frequency of urination, pain

which may be referred to the urethra, bladder, sacral, inguinal, or one or both lumbar regions, burning or smarting, urgency, difficulty, partial incontinence and dribbling. Residual urine, he states, is seldom found except in the presence of very tight strictures. Congenital strictures he believes are frequently the cause of enuresis in children, and are a frequent etiologic factor in the cystitis and pyelitis occurring in female infants and children. He also believes that tight strictures, like diaphragms or valves, are responsible for some of the cases of advanced hydroureters and hydronephrosis with destruction of the kidneys in infants born dead or dying shortly after birth.

The urine will be sterile and free from pus unless there is an associated urethritis, trigonitis, cystitis or pyelitis as is frequently the case. The strictures at times may be seen through the cystoscope but are best diagnosed by the olive tipped bougie as recommended by Stevens, or by graded Hegar dilators.

The strictures of larger caliber are usually satisfactorily treated by gradual and repeated dilatations with Hegar dilators. Sufficient anesthesia for this procedure can usually be achieved by the instillation into the urethral canal of a few cubic centimeters of a 1 to 500 solution of nupercaine (Ciba). Occasionally meatotomy or incision of the stricture may be necessary. When such a procedure is to be done, or when strictures of very small caliber are to be dilated for the fitst time, a general anesthetic is usually necessary.

Caulk[12] in 1921 reported a case of stricture in the region of the vesical sphincter which failed to respond to dilatations but was successfully cured by treatment with the cautery punch. Such cases must be rare indeed as by 1937 Caulk,[14] who had particularly emphasized them, had only encountered fifteen such cases in adult women and six in female children. In the fifteen adults twelve of the obstructions were due to inflammatory contractures and one to a papilloma. The symptoms were much the same as for other strictures with the addition of residual urine from 30 to 1000 cc. in twelve patients, overflow incontinence in four, and regurgitant renal colic in six. Eleven of the patients had pyelonephritis and the ureterovesical valves were incompetent in six. Ten were treated by the cautery-punch taking one to four bites, with satisfactory results. Histologic examination of the tissue[13] showed hypertrophy of connective tissue and smooth muscle in six, and epithelial hyperplasia in four. The production of a vesicovaginal fistula is mentioned as a possible

danger, but did not occur in Caulk's series, and no case is reported by him as having urethral incontinence as a result of treatment. Caulk mentioned reports of similar cases by Haufbauer, Nesbit, and Fite, and Thompson[202] has recently reported twenty-four cases from the Mayo clinic all of whom suffered from complete retention. The transurethral operation did result in stress incontinence in one of these. We have observed only one such case in our clinic. This was a patient of Dr. Hunner's in whom the contracture followed a post-operative infection in the space of Retzius. Transurethral operation relieved the retention but resulted in incontinence.

In a large and active clinic devoted exclusively to the handling of urologic conditions in women, the failure during many years to encounter other than this one patient whose urethral obstructions could not be satisfactorily relieved by repeated dilatations, emphasizes strikingly the rarity of the necessity for such procedures as the use of the cautery punch upon the vesical neck. Although no complications such as urethral incontinence or vesico-urethrovaginal fistulae followed this procedure in the skilled hands of Caulk, the potentialities of such complications are great, and although we have not seen patients in whom we deemed the cautery punch operation necessary, we have seen some with incontinence following its use elsewhere. We, therefore, believe that it should be strongly emphasized that this method of treatment of urethral obstructions in the female should be resorted to only after all other methods have failed.

5. Suburethral Abscess and Diverticulum. These conditions, while generally considered to occur but rarely, have been the subjects of numerous reports and are believed by some authors to occur considerably more frequently than they are observed. The diverticula at least because of their tendency to periodic emptying may readily be missed by an examiner. Cullen[27] in reporting a case in 1894 collected thirty-seven others from the literature, and Schmitz[177] in 1939 found one hundred cases in the literature and had observed eight cases in ten years on his own service. The cases reported are for the most part diverticula, and acute abscesses are but seldom mentioned. Two patients with acute abscesses, however, were recently admitted to the gynecologic service of the Johns Hopkins Hospital within a period of two weeks. In one in which the abscess was quite large involving the whole of the urethrovaginal and vesicovaginal septum (Fig. 7) no communication could be demonstrated between the abscess cavity and the urethra. In the other with a smaller

abscess such a communication was present and pus could be expressed from the urethra. Both patients presented the same symptoms of gradually increasing difficulty in voiding over a period of two

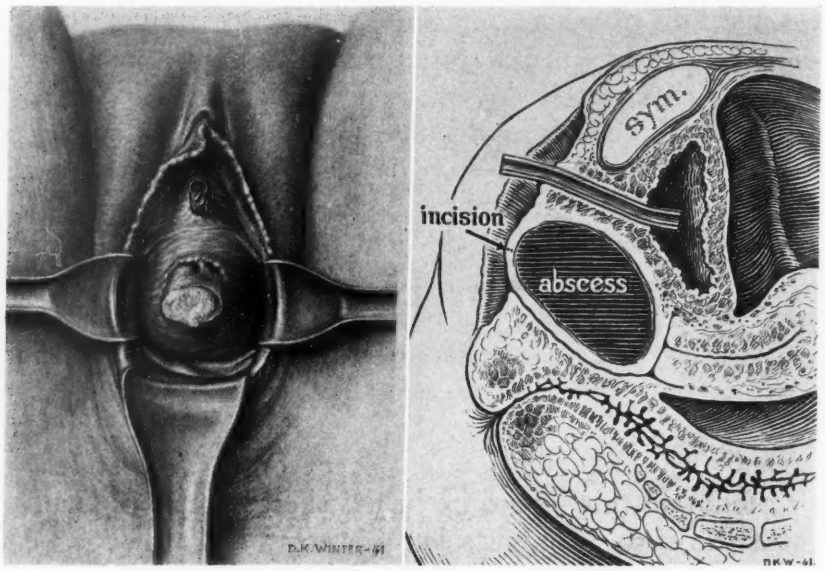


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FIG. 7. *a*, direct view of a large suburethral abscess with the patient in the lithotomy position. *b*, schematic drawing of a medium longitudinal section through the same abscess.

weeks, culminating finally in acute retention of urine. Fever and leucocytosis were present in both, though these were of greater degree in the patient with the larger abscess without urethral communication. Both abscesses were incised and drained through the anterior vaginal wall, and anaerobic streptococci were grown from the pus obtained in each instance. An inlying catheter was left in the bladder for forty-eight hours in each case, and both patients voided normally after removal of the catheter. Healing was satisfactory in both, and on subsequent examination no urethrovaginal fistula had occurred in either. Although the development of such a fistula might readily occur in those cases with a communication between the abscess cavity and the urethra, incision and drainage is the only satisfactory method of treatment for a true abscess. If such a fistula should occur, closure may be attempted later.

Many theories have been advanced as to the etiology of urethral diverticula. Cysts may arise from congenital rests in the urethrovaginal septum such as Gärtner's duct or occluded paraurethral

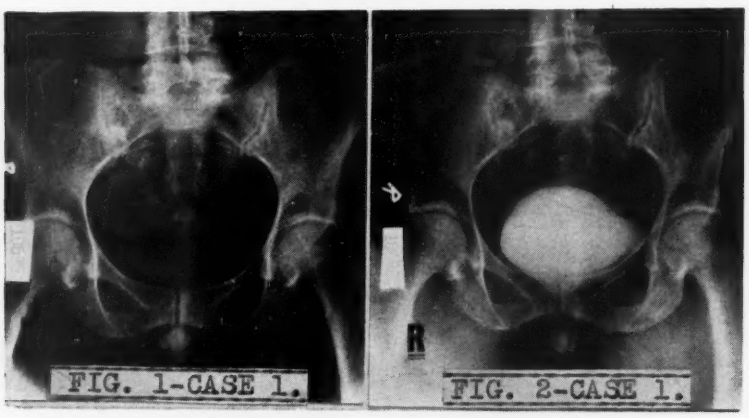
glands. Clark M. Johnson,[103] who reported a suburethral cyst, which did not communicate with the urethral lumen, occurring in a newborn infant, believes that such cysts may occur frequently and become converted into diverticula by rupturing into the urethra. J. Craig Neel[160] reported a case which he believed to be congenital in origin, because of the absence of urinary infection, the insidious onset of symptoms without pain or tenderness, and the unusually large communication with the urethra which extended upward to involve the region of the internal sphincter and vesical orifice. The consensus of opinion among most of those who have contributed to the subject, however, is that in most instances urethral diverticula are acquired rather than congenital. Some authors make a distinction between true diverticula in which all coats of the urethra can be identified in the wall of the diverticulum, and false diverticula or urinary pockets in which these structures cannot be found. Such a distinction, it would seem, is of little practical importance.

Schmitz[177] mentions structural weakness, trauma usually from labor, and infection as the most common etiologic factors in acquired diverticula. The formation of a diverticulum to accommodate a stone lodged in the urethra behind a stricture was mentioned by Cullen[27] and in 1934 Shivers and Cooney[184] who reported such a case, were able to find reports of twenty-two others. A more recent review by Gaston and Ferrucci[50] has brought the total number of such cases reported up to thirty-four.

The symptoms are usually pain in the region of the urethra and vagina which is accentuated in the sitting position and particularly during coitus. A tender mass may be observed and felt protruding from the vaginal orifice. There is usually a history of intermittent discharge of cloudy or purulent urine from the urethra, which is followed temporarily by relief of symptoms. The urine is often infected in which case frequency, urgency and pain on urination will be present.

Examination reveals a fluctuating, somewhat tender mass in the urethrovaginal septum, compression of which results in the discharge of cloudy urine from the urethral meatus. If multiple calculi are present crepitus can be elicited. The opening in the floor of the urethra can be demonstrated through a Kelly speculum, and an opaque solution may be injected through this opening into the sac for the purpose of obtaining a roentgenogram, though such a procedure is not necessary for diagnosis.

The treatment should consist of excision of the sac through a vaginal incision with careful closure of the urethral opening and reconstruction of the structures beneath the urethra. Shivers and



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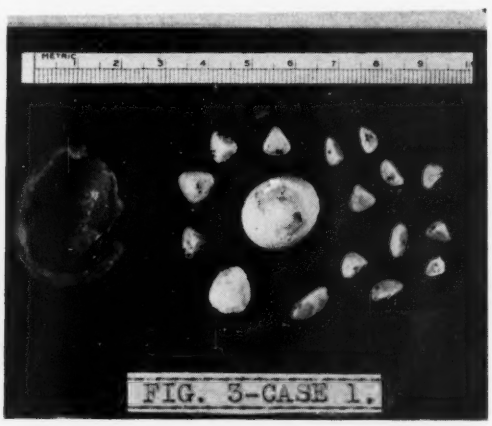

c

FIG. 8. Illustrating a case with calculi in suburethral diverticulum. Fig. 1, *a*, Case 1. Glass catheter in bladder. Mottled dense shadow below symphysis showing calculi in sac of diverticulum. Fig. 2, *b*, Case 1. Cystogram with 200 cc. Three per cent NaI; catheter removed, mottled character of shadow of multiple calculi rather more distinct. Fig. 3, *c*, Case 1. Photograph of half of sac wall after shrinking by the fixative. Seventeen calculi. (Figure and legends from Hunner, G. L. *Urol. & Cut. Rev.*, 42: 336, 1938.)

Cooney[184] employed a preliminary suprapubic cystotomy to divert the urine from the urethra, but such a procedure has not been found necessary by most surgeons. Furniss[49] feels that success is more apt to result if the sac is merely excised, the neck fulgurated, and the cavity packed at first, and the reconstruction procedures carried out

at a later date. In general, however, except in the presence of an unusual amount of inflammatory reaction in the tissues, such a two-stage procedure would not seem necessary. Hunner[96] who has recently reported three cases with calculi, has described the technic of the usually most satisfactory treatment so well that some direct quotations may be used:

"The treatment is practically the same whether a stone is present or not." If the urethra is strictured it should be dilated first and this "had better be done repeatedly in slow stages over a sufficient period of time to avoid open rupture of the tissues and bleeding. Severe trauma at the time of operation is likely to result in more scar-tissue and backpressure of the urine on the site of the mucosa repair where the sac is cut from the urethral wall." The operation is best done with a Hegar dilator or sound, as large as the urethra will accommodate comfortably, constantly in the canal. The anterior vaginal wall is then incised in the midline and the sac carefully dissected out and severed from its attachment to the urethra. The defect in the urethral mucosa is closed with a purse-string suture of fine forty-day chromic catgut. The suburethral tissues are brought together with interrupted sutures of fine chromic catgut and if there has been incontinence or other evidence of sphincter weakness, the urethral sphincter and tissues beneath the vesical neck should be plicated with mattress sutures of silk according to the Kelly technic. Hunner suggests that the redundant vaginal mucosa be trimmed away from only one side, so that the flap from the opposite side may be brought across the midline and sutured with silk or fine silver wire. In this way one can avoid having the line of suture of the vaginal mucosa lying directly over those in the deeper tissues. The vagina should be packed with gauze for forty-eight hours to obliterate dead space, and a rubber catheter should be left in the bladder for three or four days. The patient may be up on the fifth or sixth day but the vaginal sutures should not be removed until the tenth day.

6. *Prolapse.* The term prolapse is used at times to refer to a sagging of the entire urethra toward the vagina and its outlet as a result of weakening of the supporting tissues in the anterior vaginal wall. Such a condition is in reality an urethrocele, and confusion will be avoided by limiting the term prolapse to an eversion of the mucous membrane of the urethra through the meatus. This condition appears as a red congested tumor-like mass protruding between the labia minora, which may vary from 1 to 4 or 5 cm. in diameter. The

mass exudes a serosanguinous fluid and not infrequently thrombosis may occur with resulting gangrene, in which event the tumefaction assumes a dark purplish color.

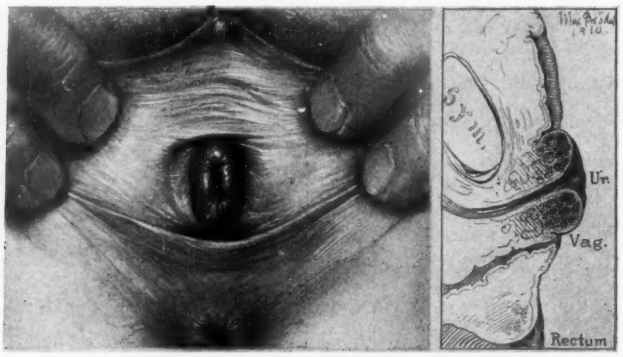

FIG. 9. Prolapse of urethra. The sagittal section shows dilated thrombosed blood vessels which impart a dark red color to the strangulated mucosa. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

The condition is rare and is apt to occur most often in childhood or advanced old age, although cases have been reported in patients in the middle period of life. Keefe[108] found 60 per cent in children under fifteen years of age, and 28 per cent in women over forty years, with only 12 per cent between the ages of fifteen and forty.

The onset of the condition may be gradual or sudden. The chief predisposing cause is generally considered to be a weakness of the urethral wall which may be congenital, the result of trauma such as may be sustained during delivery, or the result of general weakness and debility. As precipitating causes such factors as cough, straining at stool, vesical tenesmus, bladder calculi, and parturition have all been mentioned. Chute[16] has reported three cases with moderate degrees of prolapse all of which had been treated as caruncles. When the symptoms were not relieved, further investigation disclosed the presence of a bladder tumor in each case. Such a possibility should certainly not be overlooked in searching for the cause of prolapse. Keefe[108] believes that a neuromuscular disturbance resulting in too forceful activity of the detrusor urinae muscle may be an important factor.

The symptoms may be relatively slight and consist merely of the presence of the tumefaction with its serosanguinous discharge, or there may be frequency and burning on urination, or even difficulty in voiding with severe vesical tenesmus.

Various treatments have been recommended, but in general non-surgical methods such as the application of astringent compresses have met with little success. Of the surgical procedures used that recommended by Kelly and Burnam[121] has probably been employed most often as it is applicable to both children and adults, and despite the fact that it has not met with the approval of some (Keefe,[108] Livermore[139]) it has generally been reported as giving highly satisfactory results. In this procedure the base of the tumor is first transfixed with a suture to prevent retraction of the mucous membrane. The tumefaction is then excised and the margins of the urethral mucosa are sutured to the vestibular mucosa in a manner similar to the Whitehead operation for hemorrhoids. Emmet's "button hole" operation consists of a small incision through the anterior vaginal wall down to the urethral mucosa through which the mucosa is drawn thus retracting the prolapse. The redundant mucosa is removed and the defect closed after which the vaginal incision is closed. Keefe[108] recommended a reduction of the prolapse after which the urethral wall throughout its whole length was tightened by sutures through a vaginal incision. Both of these procedures are only applicable to adults. Hepburn[60,61] has used successfully a suprapubic approach through which the vesical neck is freed and lifted upward until the prolapse is seen to disappear. The bladder neck is then sutured to the periosteum of the pubic arch. Livermore[139,140] has been successful with mere fulguration as he says "at four points of the compass." Such a procedure should be most useful in the very elderly patient who is hardly a good risk for more extensive procedures. Before this is done, however, at least a small piece of the prolapsed tissue should be excised for microscopic study in order surely to differentiate it from carcinoma. TeLinde (personal communication) has successfully fulgurated the whole mass, but in most cases the procedure recommended by Livermore is probably adequate and less apt to result in a stricture of the urethral meatus.

7. *Neoplasms.* Except for caruncles true new growths of the female urethra occur very rarely. In a series of thirty-five patients reported with what they termed proliferative lesions, Walther and Willoughby[212] in 1935, included three cases of cysts of the paraurethral glands, and one of prolapse of the urethral mucosa. These of course should not be considered as new growths. Of the new growths there were four papillomas and the remaining cases were either caruncles or carcinomas. In their series in only fifteen was a path-

ologic examination made of the lesion. Of these fifteen one showed definite carcinoma, while a suggestive carcinomatous or "precancerous" lesion was found in five others. In three of these the suggestive

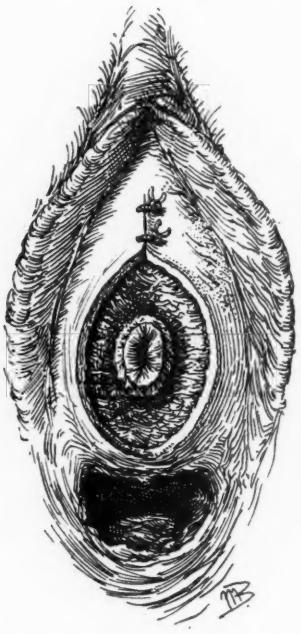

FIG. 10. Appearance after circular amputation of prolapsed and hypertrophied urethral mucous membrane. The wound is closed from side to side, above and below with interrupted fine catgut sutures. The remaining central portion is united to the urethral mucosa on the two sides. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922, D. Appleton & Co.)

malignant changes had occurred associated with an old chronic inflammation, while in two others they were found in caruncles. These findings led the authors to the following conclusion sufficiently important to be worthy of direct quotation:

"The many reports received in personal communications from leading urological clinics throughout the country, as well as a study of the series herewith reported, reveal the fact that many of the

proliferative lesions of the female urethra removed and studied microscopically show either malignant or premalignant changes. A warning, therefore, should be sounded against the removal of such

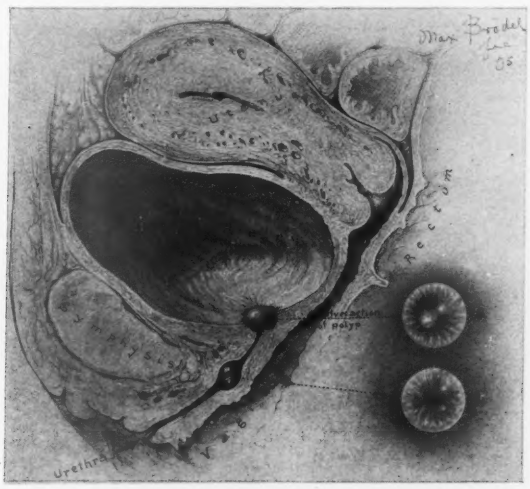

FIG. 11. Mucous polypi of urethra and sphincter region of the bladder. The smaller drawings, (*a*) and (*b*), show the polypi as seen through a Kelly cystoscope. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

lesions by the haphazard methods often employed (actual cautery, and so on), without submitting biopsy specimens to the pathologist in every instance. It is only by routine studies that the actual incidence of urethral carcinoma in women can be determined."

These authors do not state the location in the urethra of the papillomas but Folsom[46] and others have described such lesions occurring in the posterior urethra near the sphincter on the basis of a chronic urethritis, and Kelly and Burnam[121] illustrate probably the same lesion under the name mucous polypi. (Fig. 11.) Such lesions after the removal of adequate biopsy specimens may be further destroyed by thorough fulguration. Fibromas and sarcomas of the urethra do occur but have been reported but rarely. Kelly and Burnam[121] cite in brief detail seven cases of myomas or fibromas collected from the literature and mention twenty-seven others collected by Lönnberg. The same authors cite fourteen cases of sarcoma as having been collected by Ehrendorfer, and twenty-two of 149 cases of malignant tumor collected by Menville and Counseller[154] in 1935, were of this variety.

Caruncle. These tumors occur frequently and appear as small brilliant red, soft masses attached to the mucous membrane of the posterior aspect of the urethral meatus. They are usually only a few millimeters in diameter but may be considerably larger. They may be sessile or attached by a pedicle. Occasionally they may be multiple and spring from the entire circumference of the external orifice.

Microscopically they may appear as polypi with a loose fibrous stroma containing many thin-walled blood vessels and usually infiltrated with inflammatory cells, round cells and polymorphonuclear leucocytes. The vascularity is so marked in some that they have been considered as angiomas. The surface is covered by stratified squamous epithelium or by transitional epithelium in about equal proportions of the cases (Olcott[164]), and occasionally both types of epithelium may be found in the same specimen. The epithelium often tends to dip down into the stroma forming crypts, with resulting patterns which on cursory examination might suggest carcinoma. More careful examination, however, usually shows a uniformity of cell structure and lack of nuclear activity which leaves little doubt of their benign nature. At times the structure is typically papillomatous.

These tumors may be entirely insensitive and produce no symptoms. On the other hand many of them are exquisitely sensitive, and when this is the case the patients suffer severely from urethral pain; and although frequency, urgency and dysuria are present as a rule, the pain on voiding may be so great that the patients may voluntarily refrain from doing so to the point of overdistending the bladder. The symptoms from these apparently insignificant tumors may be so distressing as to shatter the nerves of the patient completely.

Various technics have been suggested for treatment including incision and suture, destruction with chemicals or the actual cautery and fulguration. In general there are three important principles that should be observed and provided this is done the actual technic is not important: These principles are first that a sufficient amount of the tumor be removed and preserved for microscopic study, secondly, that the mucous membrane at the base must be completely removed or destroyed to prevent recurrence, and thirdly that the removal or destruction must be done in such a way as to avoid scarring sufficient to produce a stricture of the meatus. We have found excision of the tumor with fulguration of the base a simple and satisfactory procedure, which usually can be carried out under local anesthesia, except

in those patients rendered highly nervous by the extreme sensitiveness of the lesion. The patient should be warned of the great tendency to recurrence and advised to seek prompt treatment and not to worry about cancer.

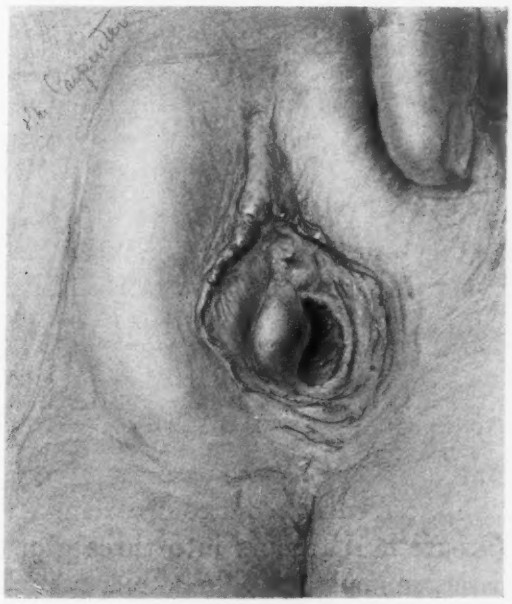

FIG. 12. External genitalia of a girl aged ten, showing a bulging prominence to the right of the vaginal orifice. This prominence marked the site of the orifice of an ectopic ureter, and a steady dripping of urine occurred from this region. (From Everett, H. S. *South. M. J.*, 31: 843, 1938.)

Carcinoma. Carcinoma of the female urethra, while rare, occurs more frequently than any other truly neoplastic lesion except caruncle. Menville and Counseller[154] in reporting a case in 1935 found 149 other cases of authentic malignant neoplasms in the literature, of which twenty-two were sarcoma and the rest carcinoma. In a more recent study Sala and Levine[174] found 262 reported cases. Olcott[164] in reviewing the cases of caruncle in the records of the New York Hospital could find no case of carcinoma, and in 1923 Shaw[183] was able to find only twelve cases reported in the British literature. Whitehouse,[219] who was later quoted by Watson[216] divided the tumors into vulvo-urethral and urethral types, and of the forty-three authenticated cases which he (Whitehouse) was able to collect, thirty-two were of the former variety. This fact may in part account for the

infrequency of reports, since in the advanced stages of the vulvo-urethral variety it is impossible to determine whether the tumor was primarily vulval or urethral in origin. The cases collected by Whitehouse ranged from twenty-six to sixty-nine years of age with an average of fifty-four, and in Crossen's,[25] twenty-five collected cases the youngest was twenty-eight and the oldest seventy.

Although, as is always true of neoplastic diseases, nothing definite can be said as to etiology, the frequency with which carcinomas have been preceded by caruncles, or chronic inflammatory lesions has been stressed by a number of writers, notably Pugh,[170] Watson[216] and Crossen.[25] This fact tends to enhance the value of the quotation cited above from the article of Walther and Willoughby[211] as to the importance of biopsy in proliferative lesions.

The majority of the tumors histologically are found to be squamous cell epitheliomas, although some adenocarcinomas, probably arising from paraurethral glands have been reported. Of the cases collected by Whitehouse[219] twenty-seven were of the former and fourteen of the latter varieties. The case reported by Menville and Counseller[154] was described as a mucoid carcinoma. Whitehouse[219] divided the vulvo-urethral tumors into three groups according to gross characteristics, namely, papillomatous resembling caruncles, ulcerating lesions at the meatus, and slow growing, nonulcerated, indurated lesions encircling the meatus. The true urethral growths he divided into two groups: elongated ulcerating growths involving the floor of the urethra, and periurethral infiltrating growths which tend to occlude the canal. Metastases from the vulvo-urethral variety tend to occur first in the inguinal lymph nodes, while those from the urethral variety reach the deep pelvic nodes first. A case has been reported by E. C. Shaw[182] in which the tumor surrounded the urethra but did not involve the mucosa. The primary tumor disappeared following irradiation, but two years later the patient died from bilateral ureteral occlusion due to metastases in lymph nodes quite high along the ureters.

The symptoms are usually pain in the region of the urethra with frequency, urgency and difficulty in voiding. Complete retention of urine may occur in the more advanced cases. There is often a bloody discharge and the urine contains blood.

The prognosis is generally stated to be poor although of the twenty-five cases collected by Crossen,[25] eleven had survived for more than two years. W. F. Shaw[183] has called attention to the fact

that most cases have been reported before enough time had elapsed after treatment to permit of satisfactory evaluation as to results.

Four methods of treatment have been advocated as follows: (1)

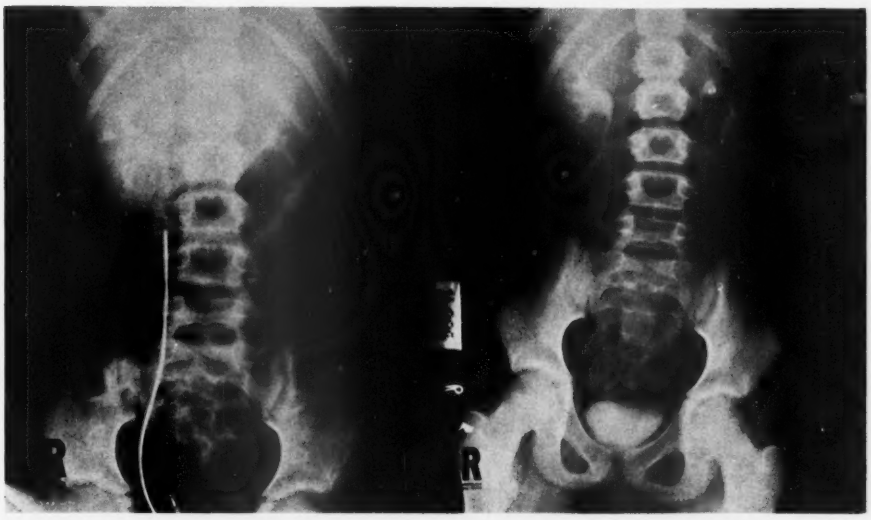

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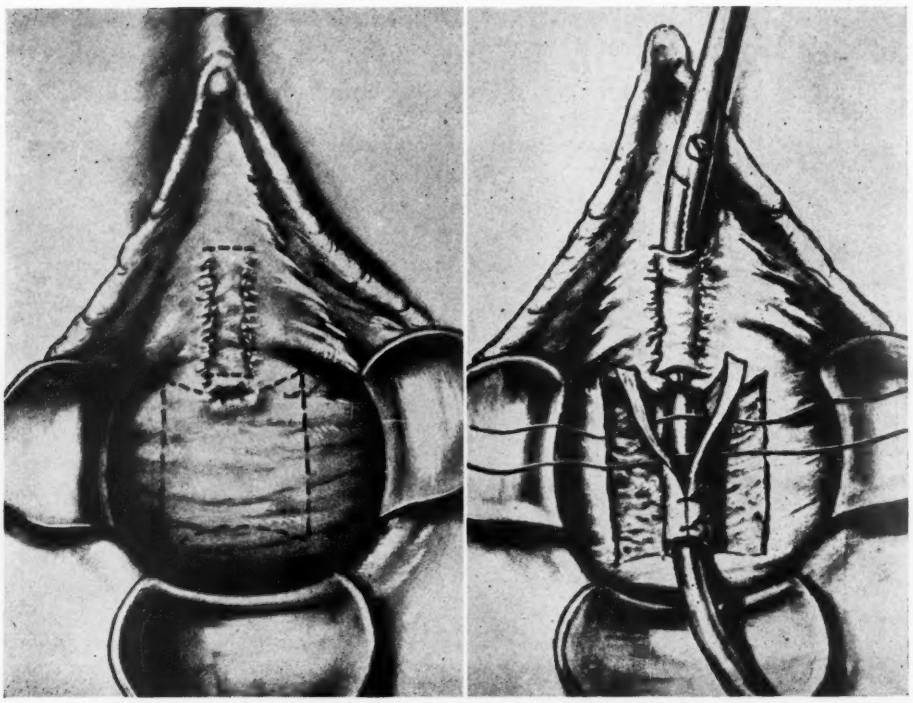
FIG. 13. Intravenous pyelograms of the same patient illustrated in Figure 12, (*a*) before and (*b*) eight months after abdominal ligation and partial resection of the aberrant ureter. In (*a*) the normally placed right ureter draining the lower segment of a double pelvis had been catheterized, and the catheter plugged to prevent the escape of the opaque solution. (From Everett, H. S. *South. M. J.*, 31: 843, 1938.)

Radical excision of the urethra and surrounding tissues including a portion of the bladder neck. The defect in the bladder is closed and drainage instituted through a vaginal or suprapubic cystotomy wound. (2) Less radical excision leaving the vesical neck and sphincter region. This procedure was used successfully in two cases by Crossen[25] who first diverted the urine through a vaginal cystotomy. He took particular pains to tighten the tissues around the vesical neck by three purse-string sutures and then covered the raw areas by transplanted flaps of vaginal mucous membrane. His efforts were rewarded by complete urinary control. (3) Excision or high frequency loop extirpation of the tumor followed by radium and roentgen therapy as advocated by Walther and Willoughby.[212] (4) Radium and roentgen therapy alone.

In the cases treated surgically the inguinal lymph nodes should also be removed. The decision as to methods of treatment must be decided on the individual merits of each case, but it would seem that



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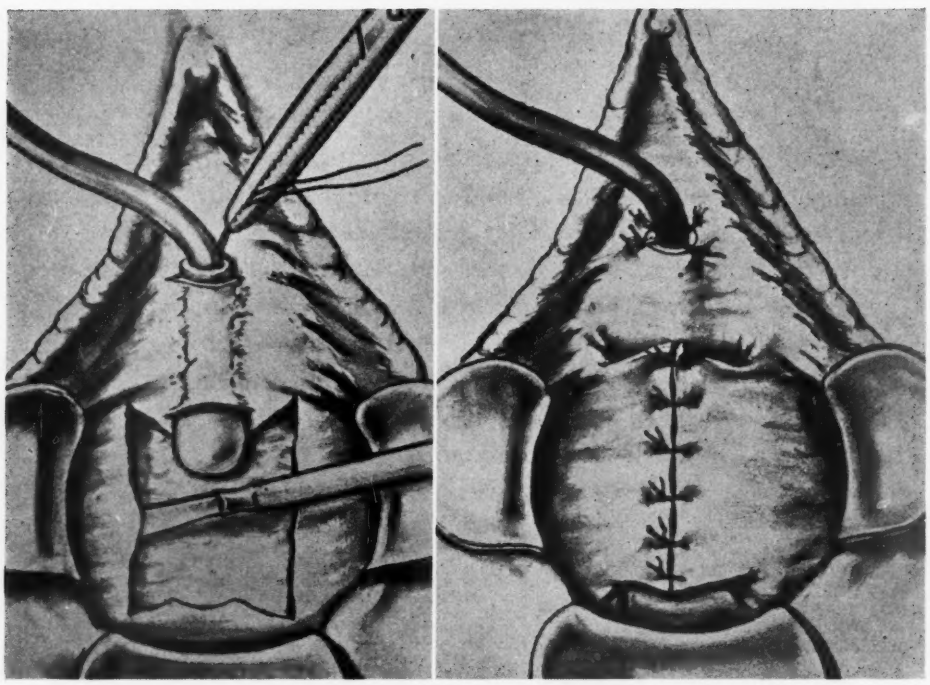

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FIG. 14. For descriptive legend see opposite page.

in cases sufficiently advanced to require the more radical type of operation, irradiation would be preferable to the mutilation and permanent incontinence necessarily resulting from such a procedure. Although no suggestion of it has been found in the literature, it would seem that in those cases in which irreparable defects and and incontinence result from operation, it might be worth while to divert the urine by transplantation of the ureters into the bowel.

IV. INCONTINENCE OF URINE

Incontinence, or the inability to control the outflow of urine, may vary in degree from an occasional slight involuntary escape of a few drops to the complete and continuous uncontrolled flow of the entire urinary output. While in its lesser degrees this symptom may cause merely a slight annoyance to the patient, those suffering from the severer degrees of incontinence, because of the constant wetting of the clothing and the attending foul uriniferous odor, in the words of Kelly and Burnam[121] "commonly live a recluse life, rarely seeing anyone outside of the immediate tolerant family." Because of the variety of causes of this condition in the female and the challenge which the difficulties of its correction often present, it is a subject which has engaged the attention of skilled gynecologists and urologists since the epoch making work of Marion Sims[185] on the cure of vesicovaginal fistula.

The causes of incontinence which occur in the female may be listed as follows:

1. Congenital defects of the urinary system:
   a. Hypospadias.
   b. Epispadias.
   c. Exstrophy of the bladder.

FIG. 14. Method of reconstruction of the urethra as described and used independently by G. G. Ward, J. A. McGlinn and S. H. Geist. (*a*), shows the scarred site of the previous urethra and the fistulous opening. The dashed lines above the opening illustrate the position of the openings of the tunnel. Dashed line below the fistula is outlining the mucosal flap for tube. (*b*), the tunnel completed, the flap mobilized, the new urethral tube in the process of completion. Note the thickness of the flap in the proximity of the new urethrovesical junction. (*c*), the new urethral tube drawn through the tunnel by means of traction sutures. The catheter which is passed through the new urethral tube into the bladder also drawn through the tunnel. (*d*), the complete operation, the new urethral tube anchored at the upper margin of the tunnel. The vaginal mucosa sutured covering the denuded area and bulbous end of the urethra. The catheter in place. (Figures and legends from Geist, S. H. *Am. J. Obst. & Gynec.*, 39: 843, 1940.)

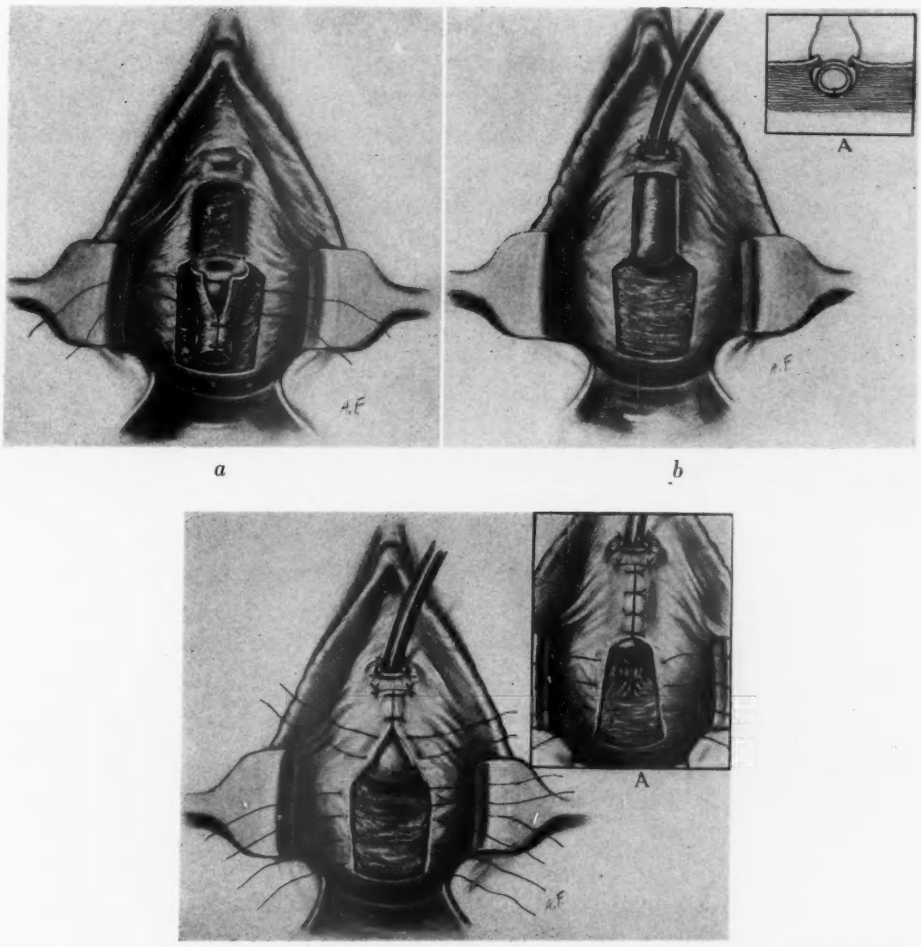
d. Anomalous ectopic opening of an ureter outside of the bladder.

II. Defects of the urinary system resulting from trauma or disease:
   a. Weakening or relaxation of the urethral sphincter mechanism.
   b. Destruction of the urethra, partial or complete.
   c. Urethral, vesical and ureteral fistulae.

III. Lesions of the nervous system involving the nerve control of micturition:
   a. Congenital lesions such as spina bifida occulta.
   b. Acquired lesions such as tabes dorsalis, multiple sclerosis, spinal cord tumors, transverse myelitis, Pott's disease and traumatic injury of the spinal cord.

1. *Congenital Defects.* The congenital defects of hypospadias and epispadias as mentioned in a preceding section are extremely rare. As these conditions may be closely simulated by defects resulting from trauma or disease, their surgical correction will be discussed later in connection with the correction of such acquired defects. Exstrophy of the bladder, a most distressing condition, is fortunately also rare. Although attempts have been made from time to time to correct such defects by plastic procedures, complete failure has usually been the reward, and it is now generally accepted that the only satisfactory treatment is diversion of the urinary stream by transplanting the ureters to the bowel, after which the exposed open bladder should be excised.

In 1938, the author[40] reported three cases of ectopic ureteral orifice and reviewed the literature up to that date. This review revealed that about 200 such cases had been reported, about two-thirds of which were in females. Kilbane,[124] in 1926, reviewed 100 cases, of which sixty-five were in females and thirty-five in males. Thom,[201] in a collected series of 185 cases, found 122 females and sixty-three males, and Sargent,[175] whose series is the same as Thom's, with one case of his own added, found 123 females and sixty-three males. Furthermore, the diagnosis is made clinically much more frequently in females. In Kilbane's series the diagnosis was made clinically in fifty-seven of the sixty-five females and in only two of the thirty-five males, thirty-three males and nine females having been diagnosed at autopsy examination. In Sargent's series ninety-four of the 123 females were diagnosed clinically and only six of the sixty-three males. The others were diagnosed at autopsy examination.



a *b*

c

FIG. 15. Dr. George Gray Ward's more recent modification of the operation for reconstruction of the urethra. (*a*), the dotted line shows the site of the destroyed urethra with the external meatus intact and a vesicovaginal fistula at the neck of the bladder. As suggested by Farrar the quadrangular flap dissected from the anterior vaginal wall and sutures passed to convert it into a tube. Note the upper margins of the flap end above the fistula. (*b*), a catheter is passed through the tube and into the bladder and the new canal is laid in a deep "U" shaped excavation that has been made at the site of the original urethra. See insert A. (*c*), the end of the canal sutured to the external meatus, and the margins of the excavation brought together with sutures over the new urethra. A mattress stitch (Kelly) is placed at the neck of the bladder. Insert A shows the mattress suture tied, and the sutures placed to close the vaginal denudation. (Figures and legends from Ward, G. G. *Surg., Gynec. & Obst.*, 58: 67, 1934.)

The failure to make a clinical diagnosis in the male, according to Sargent,[175] is due to the fact that the aberrant opening which may be situated in the prostatic urethra, ejaculatory duct, seminal vesicle, or vas deferens, is always within the external urethral sphincter so that urinary leakage is not a symptom. In the female, on the other hand, the misplaced orifice may occur within the urethra, in the vestibule, or within the vagina or uterus, and urinary incontinence is nearly always a symptom leading to search for and discovery of the anomaly. In an occasional case, where the ureter which opens into the urethra is subject to pressure from the urethral sphincter, incontinence may not occur. Such a case has been reported by Davis[32] who collected five other similar ones. The incontinence which is usually present in the female is of a peculiar type in that there is a constant leakage of urine but at the same time normal periodic voiding. This symptom is practically pathognomonic of such an anomaly and attention to this point on the part of pediatricians should lead to earlier diagnosis of the condition than has generally been the case in the past. The frequent association of serious lesions of the upper tract with these anomalies suggests that early diagnosis and treatment may be of considerable importance.

Treatment in the past has consisted of nephrectomy, heminephrectomy, ligation of the ureter either abdominally or vaginally, or some type of implantation of the ureter into the bladder, and in two cases anastomoses were performed successfully between the two pelves. According to statistics collected by Sargent,[175] nephrectomy and heminephrectomy have met with success in all cases in which they have been used, the former in twenty-two cases, the latter in sixteen. When the normally drained segment of the kidney is normal or nearly normal, nephrectomy seems too radical, for the presence of a stricture or its later development in the remaining ureter, or injury of any sort to the remaining kidney or ureter may jeopardize the life of the patient. The various types of operation for transplantation of the aberrant ureter into the bladder were successful in thirty out of forty-six cases. The greatest incidence of failure was in those cases in which the transplantation was done through a vaginal approach, eight failures out of twenty-six cases. Some type of transplantation is justifiable and even strongly indicated where the aberrant ureter is the only one draining a well functioning kidney; but when, as is usually the case, the aberrant ureter is the one draining the upper pelvis of a double kidney, the function of the segment drained by it is

usually insufficient to warrant any great effort to save it. When this is considered together with the fact that transplantation often leads to an intractable cystitis in a previously normal bladder, these types of operation seem contraindicated in most cases.

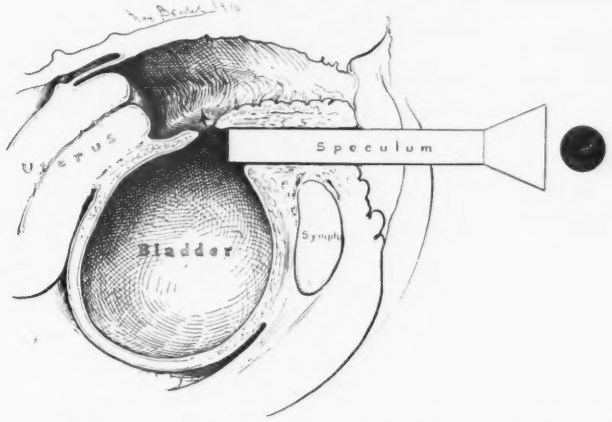


FIG. 16. Sagittal view illustrating examination of a vesico-vaginal fistula through a Kelly cystoscope. The small diagram to the right shows the speculum view of this fistula with the surrounding bladder mucosa. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

Vaginal ligation of the aberrant ureter, according to Sargent,[175] has been done six times with four failures. Two of these failures were in his own patient, whom he later cured by implanting the lower end of the ureter into the bladder, drawing it into the bladder through a vaginal cystotomy by means of a hemostat inserted through the urethra. I have found one other case of vaginal ligation, that of McKay,[148,149] which was also a failure, but the patient was later cured by resection of the upper pole of the kidney.

Aside from nephrectomy and heminephrectomy the only method of treatment which has met with complete success in every case in which it has been used is abdominal ligation and resection of the aberrant ureter. This method, however, has been neglected and even condemned as a bad surgical principle. In the presence of infection or when the ureter drains an appreciable amount of functioning kidney these objections are, of course, sound, but when there is no infection and there is evidence that the kidney substance drained by the truant ureter was not only originally small, but has already undergone some atrophy from partial obstruction below, the method offers an entirely safe method of cure, and at the same time subjects the

patient to the surgical procedure of the least magnitude of any of those offering the same probability of satisfactory result. This contention is borne out by eight patients treated in this way, all with entirely satisfactory results.

2. *Incontinence Due to Trauma or Disease: (a) Stress Incontinence.* The commonest form of incontinence is that due to weakening or relaxation of the urethral sphincter mechanism, most frequently resulting from obstetric traumas and occurring usually in association with coughing, sneezing, laughing and so on, so that it has often been referred to as stress incontinence. Dr. Howard A. Kelly[120] in 1913, described this condition so accurately and suggested such a satisfactory method for its correction that I shall quote directly from his original article.

"There is a peculiar form of incontinence of urine in women which either follows childbirth or comes on about middle age, and is not associated with any visible lesion of the urinary tract. Sometimes the most suggestive picture that can be seen by a cystoscope is a gaping internal sphincter orifice which closes sluggishly. In the incontinence which comes on at about 40 years or over the patient usually first notices the occasional escape of a few drops of urine as she makes some unusual exertion. This grows worse until, at last, a little urine runs out whenever she coughs, laughs, sneezes, or lifts anything or steps up high. The condition may finally become so bad that the underclothes are constantly wet and soiled with the malodorous secretions.

"For a long time surgeons have tried to relieve this condition by a variety of operations, some of them more or less bizarre, designed to act upon the external urethral orifice by contracting it, or to resect the vagina at the internal orifice, or to kink the urethra, or in one way or another to compress it. These operations rarely succeed. I have seen many patients subjected to them, but none relieved.

"The key to successful treatment lies at the internal orifice of the urethra and in the sphincter muscle which controls the canal at this point. For the past 10 or 12 years I have been operating constantly upon patients suffering from this minor distressing inconvenience and I have succeeded in relieving every case where there had not been a destruction of the tissues at the urethral orifice, that is, where there had been no vesicovaginal fistula with sloughing.

"The operation which I do is as follows: A Pesser catheter is introduced into the urethra; the tube ought to be small, not over 5 mm. in diameter. With the patient in the lithotomy position, the posterior wall of the vagina is retracted and the area at the neck of the bladder is brought down with either forceps or four guy sutures.

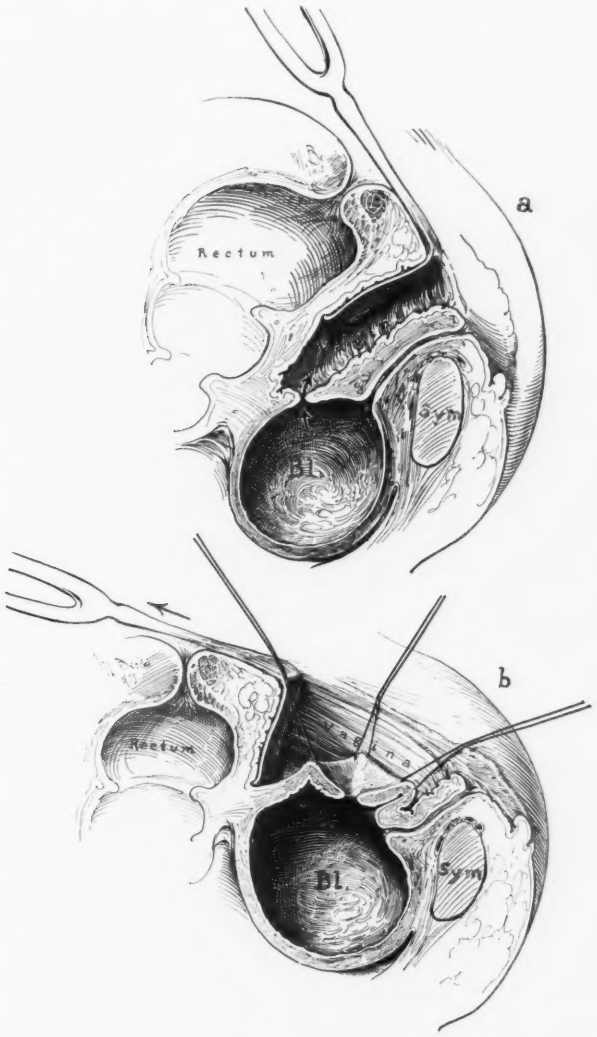
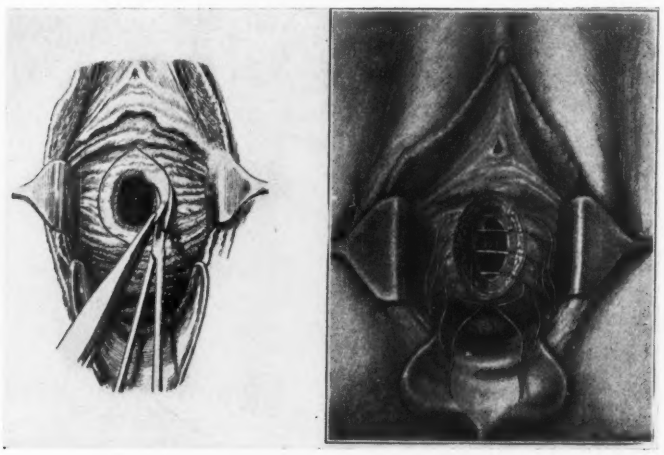


FIG. 17. Exposure of a difficult vesicovaginal fistula following hysterectomy. *a*, patient in Sims posture, with a strong retractor introduced into the vagina. *b*, the perineum and posterior vaginal wall are drawn forcefully out of the way, and the anterior vaginal wall is drawn outward by means of guy sutures. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

"The next step is to slit the vaginal wall down to the urethra and the bladder in the median line for about 1½ or 2 inches. The neck of the bladder should fall at about the center of the incision. The position of the neck is



a *b*

FIG. 18. Closure of a vesicovaginal fistula by the classical method of Sims. *a*, paring the edges of the fistula. *b*, the sutures placed. Sims used fine silver wire as a suture material and this is still the choice of many surgeons. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

easily determined at all times by moving the catheter to and fro, and feeling its head, which presses close up against the urethra. The utmost care should be taken not to cut into the urethra or the bladder at any step of the operation. After making this median incision the vagina is further dissected off on both sides with tissue forceps and dissected away for a distance of 2 to 2½ cms. around the neck of the bladder. This dissection may be made with blunt pointed scissors which push their way into the tissues, separate the bladder from the vaginal walls, and then cut the connecting fibrils. The dissection should be deepest at the neck of the bladder.

"When the detachment of the vagina from the bladder is completed, the finger should be able to grasp at least one-half or two-thirds of the neck of the bladder including the contiguous urethra. Sometimes the bladder wall is so thin that its mucosa shines through.

"The next step is to suture together the torn or relaxed tissues at the neck of the bladder, using 2 or 3 mattress sutures of fine silk or linen passed from side to side. The first suture, taking in about 1½ cms. of tissue, is tied at once, when the succeeding suture may be passed outside this, further contracting and bringing together the tissues at the neck. This is the principal part of the operation, and when done the mushroom catheter ought to be pulled out, the head of the catheter escaping with a little jump

as it clears the tightened reconstructed sphincter at the neck of the bladder. The more or less redundant vaginal walls, which have been detached in order to expose the sphincter area, are now resected so that the remaining tissues can be snugly brought together from side to side, so as to support the vesical area operated upon and avoid any dead space between bladder and vagina. I prefer to do this suturing with a continuous fine catgut suture in one or two layers."

Those of us trained in Kelly's clinic, and many others, have found that this procedure gives almost universally satisfactory results if limited to the type of case for which it was intended. If applied to cases in which the defective sphincter mechanism results from improper or defective innervation, failure is almost certain to result. Recent investigations along the lines of cystometry and roentgenographic studies of the urethra have resulted in valuable additions to our means of determining more accurately the exact nature of the incontinence in each case, and therefore enable us better to determine the best lines of treatment. As stated by Barnes,[5] "stress" incontinence may result from an increase in urinary expulsive force or intravesical pressure, a lowering of the powers of resistance of urethral sphincter action, or a combination of both of these factors. Cystometric studies are especially helpful in determining the presence and the degree of the first of these factors, while urethrograms properly made and interpreted give much information as to the second. Kennedy[123] has devised an elaborate instrument for the taking of urethrograms, the principle of which has been simplified by Barnes,[5] so that a balloon made of two finger cots is connected with a reservoir of strong sodium iodide by means of which the pressure within the balloon can be varied. The bladder is filled with 180 cc. of weak (8 per cent) sodium iodide solution after which the balloon is placed in the urethra. With the pressure in the balloon at 35 cm. of water weakness in the urethral sphincters is demonstrated by their inability to compress the balloon as shown in the *x*-ray. By varying the pressure the exact strength of different portions of the sphincter can be determined. If there is a marked increase in the intravesical pressure with normal urethrogram, the cause of the increased pressure should be sought for and corrected. Such a condition often occurs in the last trimester of pregnancy as a result of pressure upon the bladder from the pregnant uterus, and the same situation may be simulated by large pelvic tumors. Barnes[5] has further shown that in cases of descensus of the uterus cystometric studies show an in-

creased intravesical pressure which tends to disappear when the prolapsed uterus is replaced. The intravesical pressure may also be raised by large rectoceles pressing against the bladder. Disturbances

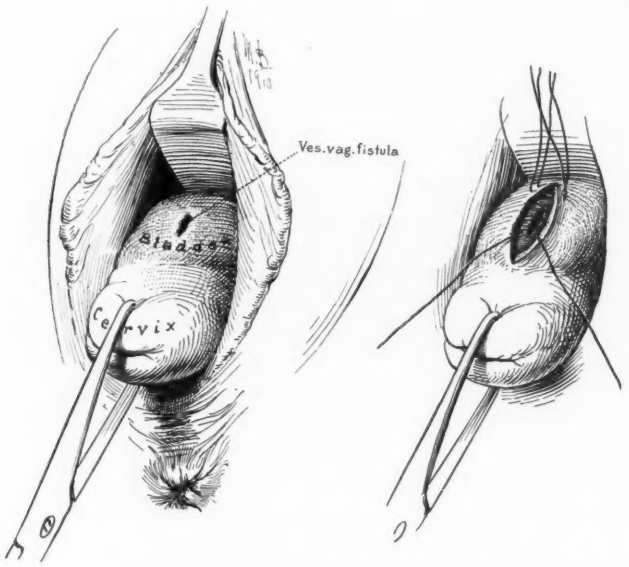


FIG. 19. Closure of a vesicovaginal fistula with dissection of the vaginal wall from the bladder and suturing in two layers. Procedure rendered quite simple by the fact that the cervix and the anterior vaginal wall can be drawn almost out of the vaginal introitus. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

of the motor innervation of the bladder musculature such as result from spina bifida occulta and multiple sclerosis often lead to such spastic contractions of the bladder as to produce incontinence. Reflex irritability of the bladder as a result of irritable ureters resulting from stricture not infrequently causes urgency to the point of incontinence. Indeed Hunner,[77] after an experience with about 750 patients suffering from incontinence, believes that this is probably the most frequent of all causes of this complaint in women, and that the first procedure in searching for the cause of incontinence should consist of examining the ureters for strictures. His experience has been that if strictures are found their thorough dilatation will often result in relief of the incontinence without further procedures; but that if this should fail to be the case, the improved health of the patient resulting from the adequate renal drainage renders her a more suitable subject for the necessary operative procedures. He has

particularly emphasized the probability of ureteritis of focal infection origin as the most likely cause of incontinence in those patients who only experience the symptom intermittently. In all cases due to intravesical tension surgical procedures upon the urethral sphincters are not apt to relieve incontinence, unless at the same time the causes of increased intravesical pressure are removed, and if indeed the urethrogram has shown no evidence of sphincter weakeess, the correction of the cause of intravesical pressure should be all that is necessary.

When there is sphincter weakness, there seems to be considerable difference of opinion as to which sphincter is most often involved, and therefore as to the best method of surgical approach. Kelly's operation is based on the hypothesis that the important weakness is in the vesical or involuntary sphincter, while H. W. Johnson[105] believes that the most important factor is a tearing or thinning of the external sphincter. His operation carries the plication further down along the urethra in an attempt to locate definitely and bring together the separated ends of the external sphincter. E. L. Young[222] in a very satisfactory article on the subject has divided the cases of obstetric origin into two groups. In the first group the patients are usually young and the onset of the incontinence is sudden and is noticed within a period of a week to several months following delivery. In these the incontinence is severe and often complete. At operation the separated ends of the external sphincter can be found retracted laterally and can be brought together by mattress sutures and reunited beneath the urethra. In the second group, which corresponds more closely to that described by Kelly, the patients are older, the onset of incontinence has been more gradual and the amount of the incontinence is usually much less. He believes that in this group there is a gradual relaxation of all sphincter muscles without tearing, and that the operation should consist of a tightening of the vesical neck after the method of Kelly, which should then be reinforced by bringing together the strong lateral portions of the suburethral muscle and fascia (extrinsic sphincter). The author's personal opinion is that Kelly's operation automatically accomplishes this in the vaginal closure, particularly if this is done in two layers.

Kennedy's[122,123] theory of the cause of incontinence of this type is considerably more elaborate than that of most other investigators. He believes that both internal and external sphincters are involved,

but that the involvement of the internal sphincter is not due to weakness but to distortion and interference with symmetrical closure as a result of adhesions formed in the tissues between the vesical neck and

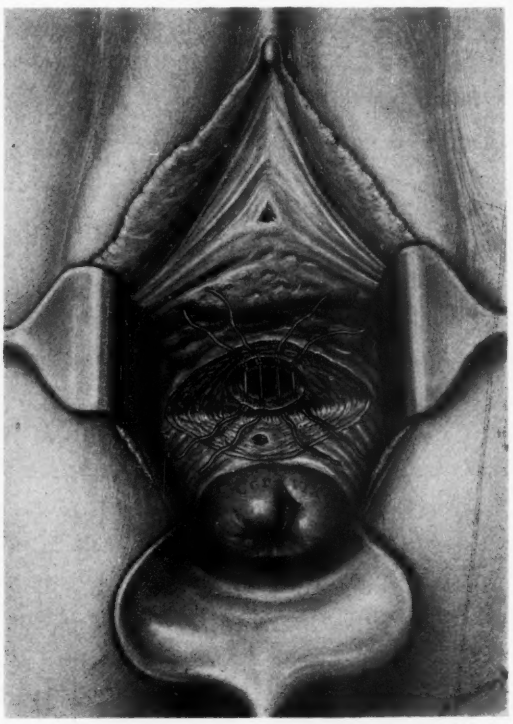


FIG. 20. Closure of a vesico-uterine fistula from below. The sutures closing the denuded and mobilized bladder are in place, ready to tie. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

the symphysis pubis. He, therefore, advocates an operative procedure which begins with a complete disection around the vesical neck and upper urethra to break up these adhesions. After this the suburethral tissues are plicated in the midline to strengthen the torn or attenuated external sphincter. He reports complete success in twenty-six of twenty-eight patients treated by this method, five of whom previously had been treated unsuccessfully by other methods. To the author, in view of the degree of success achieved by many competent surgeons with the Kelly type of plication of the vesical sphincter and careful reconstruction of the suburethral supporting tissues, the wide dissection for freeing of supposed prevesical and

preurethral adhesions seems not only unnecessary but also somewhat hazardous.

Taylor and Watt[197] among others have emphasized the fact that with cystocele and prolapse the dragging of the prolapsed posterior part of the bladder neck upon the sphincter tends to hold it open. It is, therefore, of primary importance that, in addition to whatever operative procedure is done for sphincter weakness, any prolapse or cystocele should at the same time be carefully corrected. Davies[31] believes that the levator ani and bulbocavernosus muscles also play an important part in strengthening and assisting the action of the external sphincter. He recommends a firm plication of all the tissues of the anterior vaginal wall from the urethral meatus to the cervix, after which a perineorrhaphy should be done in which the denudation should be carried sufficiently far forward to permit actual identification and resuturing into the perineal body of the retracted ends of the bulbocavernosus muscles.

In summary, an analysis of the rather extensive literature upon this subject, of which only a few representative articles have been referred to, leads to the following conclusions:

First, that urinary incontinence occurs frequently in the presence of an intact urethral tube, and that such incontinence may vary from the loss of only a few drops of urine on sudden increases of intra-abdominal or intravesical pressure (stress incontinence) to the complete inability to control the escape of urine from the bladder.

Secondly, such incontinence may be the result of increased intravesical pressure, weakness or absence of sphincter activity, or a combination of the two.

Thirdly, that an accurate diagnosis as to the degree to which each of these factors enters into the causation of the incontinence is essential to the undertaking of successful treatment.

Fourthly, that cystoscopic and urethroscopic examinations, cystometry and urethrography are all helpful in establishing such a diagnosis.

Fifthly, that having eliminated increased intravesical pressure as a factor, or having found it and corrected its cause, the attack upon the urethra should depend upon the amount of incontinence and the degree of sphincter weakness as demonstrated by urethrograms. Where the incontinence is slight or of moderate degree, and where the urethrogram shows only a moderate funnel-shaped dilatation at the vesical orifice, a Kelly plication is usually adequate. When the

dilatation extends lower into the urethra, more careful attention to restoration of the external sphincter is required. In those cases in which the whole urethra appears dilated under low pressure, particularly if there is reason to believe that the defect is due to lack of normal nerve control, some type of muscle transplant is necessary for the restoration of continence.

b. Destruction or Absence of the Urethra. Destruction or absence of the urethra occurs rarely and may result from several causes. Complete hypospadias should be classed in this group, but as pointed out by Cecil[15] in a careful analysis of forty-seven supposed such cases collected from the literature, it is not always possible to be sure whether the condition originated as a congenital defect or was acquired later through some other cause. In the acquired cases the defect most often results from obstetric traumas, either a sloughing of the urethra as a result of prolonged compression between the head of the child and the symphysis pubis, or less frequently the urethra may be torn away by misplaced forceps. A third cause is surgical destruction of the urethra, either intentionally as in the radical resection for carcinoma, or accidentally as in the cases cited by Kelly and Noble.[118] Ulcerative lesions particularly lymphopathea venereum may finally result in such complete destruction of the urethra, and the author has seen at least three such cases.

In these cases there is always a fistulous opening into the bladder in the region of the vesical neck, and there may or may not be some vestiges of the anterior and lateral urethral walls. Occasionally a short portion of the external end of the urethra may remain intact as in cases reported by Cecil[15] and by Ward.[213,214] Regardless of the etiology and of the presence or absence of urethral remnants, the distressing symptom of total incontinence of urine is always present and treatment should be directed toward its alleviation.

In attempting to reconstruct the urethra several plastic procedures have been devised and used with some success, although the variety of such procedures that have been recommended is probably the best evidence that none of them have achieved a very high percentage of satisfactory results. The original etiology, the previous attempts at repair, and the condition of the tissues as to scarring and blood supply, are all factors which play a part in determining the eventual outcome. All too frequently operation has resulted in the reconstruction of a semblance of an urethral tube, but without improvement in urinary control because of complete absence of any

sphincter mechanism in the new urethra. If the tube itself can be satisfactorily restored, however, control may be achieved at a second operation by transplantation of muscle strips, utilizing the levator ani muscles as recommended by Douglas,[37] the gracilis as described by Deming,[36] or the pyramidalis together with strips of rectus fascia as described by Goebel[53] and Stoeckel[195] and later modified by Miller[155] and also TeLinde.[199]

To reconstruct the urethral tube Noble[118] utilized the left labium minor. Kelly[118] made a tunnel beneath the mucosa behind the symphysis extending from just behind the base of the clitoris to the anterior margin of the defect in the bladder. Through this tunnel he pulled a flap of similar length turned down from the anterior vaginal wall above the fistula. This gave an immediate mucosal lining to only the posterior half of the new formed tube. Ward[213] at the suggestion of Farrar, McGlinn,[147] and very recently Geist,[51] making use of a similar tunnel have turned down a much wider flap from the anterior vaginal wall, the free margins of which were then sutured together over a catheter to form a complete mucosa lined tube which was pulled through the tunnel. Ward in 1934,[214] varied the technic by laying the tube into a trough between mucosal flaps at the normal site of the urethra. These methods have given much more satisfactory results so far as continence is concerned than any other not making use of muscle transplants. The more favorable results are very probably due to the fact that in closing the defect in the anterior vaginal wall from which the wide flap has been turned down, an opportunity is offered for drawing snugly together the supporting tissues beneath the vesical neck, which may be done in a manner similar to Kelly's plication of the vesical sphincter. The author has recently treated two patients by this method in both of whom the defect resulted from lymphopathea venereum. Probably because of the scarred and ischemic condition of the tissues, the reconstructed urethra sloughed in each case, but despite this fact the incontinence was greatly improved as a result of the tightening of the vesical neck. Cecil[15] rolled up a tube of mucosa from behind the symphysis which he attached around the opening into the bladder. This tube remained attached to its original site anteriorly throughout its entire length, thus leaving more of the original blood supply. Taussig[196] in 1918, described a procedure in which a band of muscle from the left levator was transplanted to give sphincter action for a reconstructed urethra, and Douglas[37] more recently in a two-stage operation first

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To reconstruct the urethral tube Noble[118] utilized the left labium minor. Kelly[118] made a tunnel beneath the mucosa behind the symphysis extending from just behind the base of the clitoris to the anterior margin of the defect in the bladder. Through this tunnel he pulled a flap of similar length turned down from the anterior vaginal wall above the fistula. This gave an immediate mucosal lining to only the posterior half of the new formed tube. Ward[213] at the suggestion of Farrar, McGlinn,[147] and very recently Geist,[51] making use of a similar tunnel have turned down a much wider flap from the anterior vaginal wall, the free margins of which were then sutured together over a catheter to form a complete mucosa lined tube which was pulled through the tunnel. Ward in 1934,[214] varied the technic by laying the tube into a trough between mucosal flaps at the normal site of the urethra. These methods have given much more satisfactory results so far as continence is concerned than any other not making use of muscle transplants. The more favorable results are very probably due to the fact that in closing the defect in the anterior vaginal wall from which the wide flap has been turned down, an opportunity is offered for drawing snugly together the supporting tissues beneath the vesical neck, which may be done in a manner similar to Kelly's plication of the vesical sphincter. The author has recently treated two patients by this method in both of whom the defect resulted from lymphopathea venereum. Probably because of the scarred and ischemic condition of the tissues, the reconstructed urethra sloughed in each case, but despite this fact the incontinence was greatly improved as a result of the tightening of the vesical neck. Cecil[15] rolled up a tube of mucosa from behind the symphysis which he attached around the opening into the bladder. This tube remained attached to its original site anteriorly throughout its entire length, thus leaving more of the original blood supply. Taussig[196] in 1918, described a procedure in which a band of muscle from the left levator was transplanted to give sphincter action for a reconstructed urethra, and Douglas[37] more recently in a two-stage operation first

turned down a flap from the anterior vaginal wall which he sutured into slits extending downward from the bladder opening. The lower portion of the tube thus formed sloughed, but enough remained so

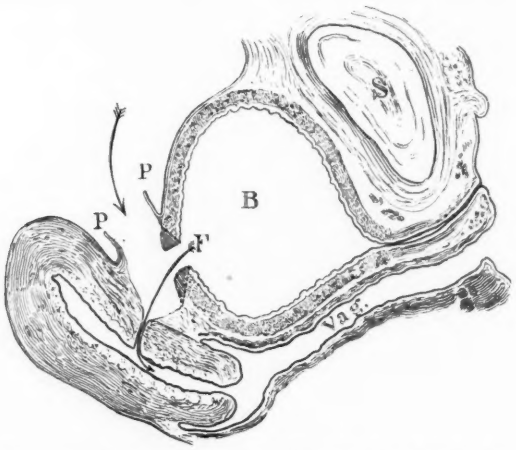


FIG. 21. Treatment of vesico-uterine fistula by abdominal incision. The vesico-uterine fold of peritoneum (P-P) is divided and the fistula (F) exposed and detached from the uterus (von Dittel). (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

that at the second operation he was able to transplant strips of the levator ani muscles around it. The urethra was then again lengthened below this new formed sphincter by pulling a flap through a tunnel as originally done by Kelly. Three patients treated in this way all acquired complete control. With all of these methods it is advised that a catheter be left extending through the reconstructed urethra into the bladder for several days. Crossen[25] in the immediate reconstruction of the urethra after resection for carcinoma, tightened the vesical neck, and reconstructed the tube from vaginal flaps. He drained the bladder through a vaginal cystotomy as he believed that the presence of a catheter in the operative field might militate against satisfactory healing. His efforts were rewarded with success in three cases. This procedure is worthy of more serious consideration than it has generally received.

c. Urinary Fistulae. Urinary fistulae, because of the deplorable condition to which they reduce the patient, and the many obstacles to successful cure which they often present, have commanded a considerable share of the gynecologic literature of the past century.

These fistulae may be conveniently classified as follows: (1) vesicovaginal; (2) vesico-uterine; (3) other vesical fistulae such as vesico-intestinal and vesico-abdominal; (4) urethrovaginal; (5) vesico-urethrovaginal involving the vesical neck and internal sphincter; (6) ureterovaginal; (7) ureterocervical; (8) other ureteral fistulae. Classes 3 and 8 of this group are extremely rare and are common to both sexes so that they will not be treated further here.

Vesicovaginal fistulae have long been a subject of particular interest to American gynecologists because of the impetus which the work of J. Marion Sims[185] upon this hitherto therapeutically baffling condition gave to our speciality. Comprehensive historical reviews of this subject have been published in 1906 and 1912 by Kelly[117,119] and in 1935 by Normal Miller,[156] and the interested reader may refer to these articles for a review of the subject as well as for complete bibliography.

Etiologically the fistulae may result from several causes. Until recent years the commonest cause was obstetric mismanagement. While occasionally a fistula resulted from a tearing into the bladder as a result of the improper application of forceps, much more frequently an unduly prolonged second stage of labor, during which tissues of the vesicovaginal septum lay incarcerated between the head of the child and the symphysis pubis, resulted in ischemia and necrosis with fistula formation. While the widespread improvement in obstetric practice has greatly reduced the incidence of fistulae from such causes, in recent years the increase in volume of gynecologic surgery and in the use of irradiation as a therapeutic agent in gynecologic surgery and in the use of irradiation as a therapeutic agent in gynecologic disorders has given rise to new etiologic factors. Complete hysterectomy, whether done by the abdominal or vaginal route, is the operation most frequently responsible for the production of fistulae, while the application of a radium plaque against the cervix in the treatment of carcinoma also not infrequently leads to a similar result. In the former instances the fistulae result usually either from a cutting or tearing into the bladder, or from strangulation of a portion of the bladder wall within a suture, which later leads to sloughing. In those cases resulting from irradiation the fistula may appear months or even years after the treatment, and as pointed out by Dean[34,35] it is usually preceded by a sloughing, bleeding ulcer within the bladder. Fistulae, then, resulting from any of these causes usually represent the completely devitalized sloughing central portion of a

much larger zone of ischemic tissue, a fact of very great importance in the determination of therapeutic procedures. Among other causes which may produce fistulae are necrosis from a neglected pessary, vaginal ulcerations such as from a broken down gumma, and extensive cervical carcinoma.

Symptoms. While the symptom of major importance, once the fistula is established, is that of urinary incontinence, there are often certain prodromal symptoms which intervene between the initial trauma and the final completion of the sloughing process with the establishment of the fistula. These symptoms usually consist of marked frequency, urgency and dysuria suggesting a severe cystitis, and often examination of the urine will reveal blood and pus. In the cases resulting from obstetric or operative traumas these symptoms usually last only a few days, after which the fistula is established and incontinence appears, while in the cases resulting from irradiation such symptoms may extend over several months, during which time painful ulcerations which tend to bleed and which are covered with grayish necrotic slough may be seen in the bladder base. Such lesions have been described by Dean[34,35] as the tertiary reaction of the bladder to irradiation. The author has observed several patients of this type, who during the ulcerative phase suffered a severe systemic reaction with fever, malaise, loss of weight and a general downhill course suggesting a rapid progress of carcinoma, although examination disclosed no evidence that this was the case. In each of these cases when the fistula became established a rapid improvement in the general condition set in immediately. Such a reaction, it would seem, can best be explained as resulting from absorption of toxins from the tissues undergoing necrosis.

After the fistula has become established, in addition to incontinence, the patient usually suffers from other symptoms resulting from the reaction of the vaginal mucous membrane and the skin of the vulva and thighs to the ever present urine. The vaginal mucous membrane may become irritated and inflamed and often is encrusted with urinary salts. The skin becomes red and scalded in appearance and not infrequently a localized furunculosis may result.

Diagnosis. While the diagnosis of large fistulae presents no problem, the very small ones must be differentiated from incontinence due to impaired sphincter mechanism on the one hand, and from ureterovaginal fistulae on the other. In the first instance, if with the bladder full there is no visible spurting of urine from the

urethra on straining, while at the same time urine continues to accumulate in the vagina, the presence of a fistula is established. To differentiate a small vesicovaginal fistula from an ureterovaginal

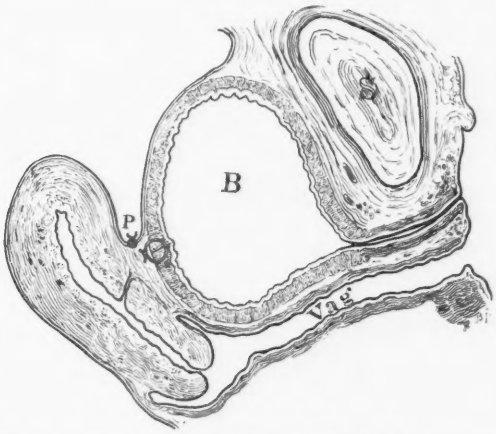


FIG. 22. Vesico-uterine fistula closed by operation from above. The hole in the bladder is now sewed up and then the vesico-uterine plica (P) is restored. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

fistula a gauze sponge should be placed in the vagina and the bladder filled with a solution containing methylene blue. If the sponge becomes stained with the blue solution, the presence of a communication between bladder and vagina is established; while if the urine which wets the sponge contains no dye, it must have come from the ureter.

In the study of a patient in contemplation of a repair of a fistula there are many points which must be carefully determined beyond its mere presence. From the vaginal side one should determine carefully the condition of the vaginal tissues, and all factors having a possible influence upon exposure for operation, such as the position of the fistula, the degree of relaxation of the introitus, and the degree of mobility or fixation of the cervix and anterior vaginal wall. The bladder should be carefully examined cystoscopically to determine the location of the fistula with reference to the vesical orifice and sphincter and particularly with reference to the ureteral orifices. Such an examination is usually easily accomplished with the Kelly cystoscope and the patient in the knee chest position, although the author was recently amazed at an article by Duncan[38] of Brooklyn in

which it was recommended that the vaginal introitus be closed by a purse-string suture, so that the vagina and communicating bladder could be made to retain enough water to permit of satisfactory cystoscopic examination. It was gratifying, however, that in the discussion of this paper both Phaneuf[168] and Sears[181] called attention to the usefulness of the Kelly instrument, although the former seemed to be under the impression that for the past twenty-five years it had largely fallen into disuse. In the author's clinic at the Johns Hopkins Hospital the instrument is still used in the urologic examination and treatment of seventy-five to one hundred patients weekly, and with the rare exception in which some orthopedic deformity prevents the assumption of the knee chest position on the part of the patient, no other type of cystoscope is required. We have rarely encountered a patient with vesical fistula, in whom the bladder could not be sufficiently expanded by atmospheric pressure to permit the location and catheterization of the ureteral orifices. The examination should always include catheterization of the ureters with determination of the separate function of the kidneys and the taking of pyeloureterograms. The ischaemic process which has produced the fistula may have involved to a lesser extent that portion of the bladder wall containing the intravesical portions of the ureters, resulting in scarring and strictures with resulting damage to the kidneys. If this is found to be the case, systematic ureteral dilatations should be carried out as a part of the preoperative preparation of the patient.

Treatment. Most of the large volume of literature that has been published upon this subject has dealt primarily with treatment. To J. Marion Sims,[185] the credit is generally given of first developing a systematic plan of treatment which could be looked to with any probability of success, although it is true that success had been achieved previously in isolated cases by several surgeons, as was duly recognized by Sims himself. According to Miller,[156] contemporarily with or shortly after Sims many brilliant contributions were also made by Jobert, Wutzer, Simon, Brown, Emmet, Bozeman and others. The plan developed and minutely described by Sims consisted of: (1) careful preoperative preparation of the patient, (2) carefully devised instruments and positions by which to secure adequate exposure for operation, (3) a skillfully planned and executed technic of operation, and (4) meticulous postoperative care. The great advances that have taken place in surgical technic since the time of Sims have resulted in innovations and improvements in the plan and

technic of operation for fistula which are often useful, but which even now in some cases cannot be used to better advantage than his original operation. Aside from such improvements and modifications in operative technic, most of the other points in his original plan of treatment are as useful today as when first enunciated.

In preparation for operation the urine should be acidified by appropriate medication, (now ammonium chloride is usually preferred) and the vagina should be prepared by hot sitz baths and warm douches, which, if encrustations are present, should be mildly acid. Silver nitrate either pure or in strong solution should be applied to ulcerated areas. At least six months should elapse after the appearance of the fistula or after an unsuccessful attempt at closure before operation should be undertaken. This gives sufficient time for any inflammatory reaction to subside and for the tissues to assume as healthy a state as possible. Just before operation is begun, if the fistula is near the ureteral orifices, both ureters should be catheterized and the catheters left in place during the operation. This greatly facilitates avoiding suturing or otherwise injuring the ureters.

The success of operation depends greatly on adequate exposure. Sims used the knee-chest and the left lateral posture with hips elevated (Sims' posture). Today the lithotomy position is usually preferred, but each of these positions is at times useful in individual cases. There is no surgical condition which calls for greater individualization and modification of technic according to the merits of each case than does this one. If the introitus is small and the cervix or vaginal vault relatively fixed, exposure may be greatly improved by the use of Schuchardt[179] paravaginal incisions. In the case of some fistulae situated high in an immobile septum, the type that often follows abdominal panhysterectomy, a suprapubic transvesical approach as recommended by Trendelenburg,[209] Kelly,[115] Young[223] and others, or the transperitoneal approach as recommended by Kelly,[115,121] Danforth[29] and others may be used to advantage. The classical operation of Sims consists of carefully denuding the vaginal mucous membrane from the margins of the fistula, after which interrupted sutures of silver wire are placed through the whole thickness of the septum down to but not to include the bladder mucous membrane. The sutures should be tied securely but not too tightly and should be left in from ten days to two weeks. Such a procedure is useful where the density of scarring between the bladder and vagina is so great as to make wide separation unduly difficult. If the sutures

cannot be tied without too great tension, this may be eased by counter incision through the vaginal portions of the septum at appropriate distances from the fistula.

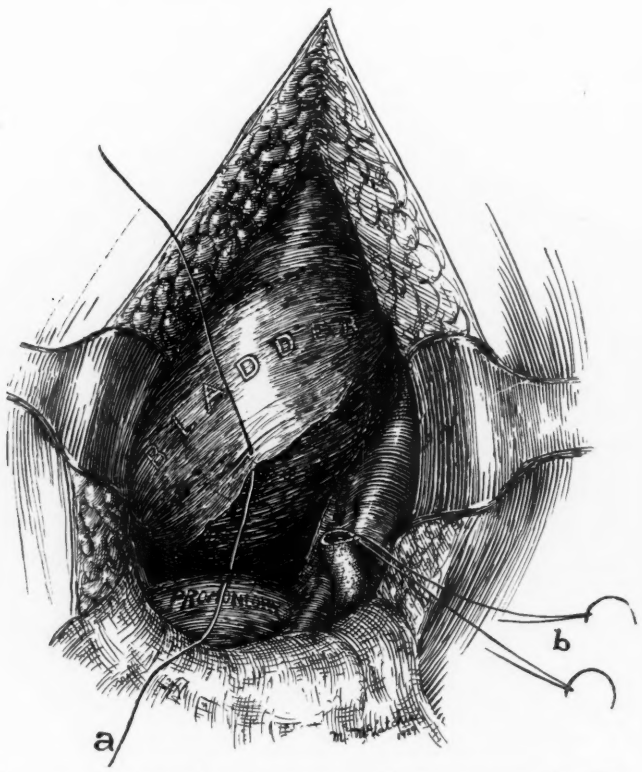


FIG. 23. Transperitoneal ureterovesical anastomosis. The ureter was injured where it passed beneath the infundibulopelvic ligament with resulting ureterocervical fistula. The segment of ureter below the injury was densely strictured and had to be sacrificed. Preliminary sutures: (*a*) for final anchoring of bladder to sacral promontory; (*b*) for dragging ureteral stump through the bladder opening and to act as a stay suture. (From Hunner, G. L. and Everett, H. S. *J. A. M. A.*, 95: 327, 1930.)

Toward the end of the last century A. Martin,[145] Mackenrodt,[144] and Kelly,[114] all independently suggested a wider denudation of the margins of the fistula with separate closure of the bladder and vagina. A further extension of this principle has been made so that now when possible an attempt is usually made to separate the vagina from the bladder well back from the margins of the fistula. The opening into the bladder is then closed with one, or preferably two rows of interrupted fine chromic catgut sutures none of which, however, should

penetrate the bladder mucosa. The second row should invert the first and the vaginal mucous membrane should be closed with interrupted silver wire sutures. If it is possible without too great tension, it is advantageous to shift the vaginal and bladder walls so that the line of suture of the vagina will not be over that of the bladder, or to have the two lines cross at right angles. If the fistula is of the vesico-uterine type, or if it lies close to the cervix, the bladder should be separated from the cervix as for an advancement operation for cystocele. After the openings in the bladder and uterus have been sutured, the bladder can then be advanced and reattached to the cervix so that the lines of closure will not be in approximation. If the fistula is of the vesico-urethrovaginal type an effort should be made to reunite the separated ends of the vesical sphincter. Failing in this incontinence will persist in spite of a successful closure of the fistula, but this may be alleviated later by some type of muscle transplant preferably of the Goebel-Stoeckel type. Urethrovaginal fistulae below an intact sphincter rarely give annoying symptoms. They may be closed by suturing over a catheter.

The above are general principles which can be modified to meet the requirements of most cases. Kelly and Burnam[121] have detailed the technic employed in a number of special types of cases and the interested reader may refer to that work. Many of the most recent articles on the subject have merely tended to emphasize in detail some particular point, such as a new method of preparation of the vagina, or of obtaining exposure, or a new suture material. While all of these suggestions are helpful and important, a detailed account of them is beyond the scope of this article. The achievement of success depends largely upon three factors: the careful preoperative preparation of the patient, the ability of the surgeon to vary the technic of operation according to the requirements of each case, and to carry out the steps of the operation with meticulous precision, and finally painstaking postoperative care.

The aim of the postoperative care should be to prevent distention of the bladder by urine, and as nearly as possible to prevent urine from remaining in contact with the operative field. To accomplish this a retention catheter should be left in the bladder for from ten days to two weeks. If the fistula is well removed from the vesical neck, a Pezzer catheter is most satisfactory; but when the operative field has approached close to this region, a plain male catheter held in by a suture is less apt to impinge upon the line of closure. If the vesical

neck has been involved, catheter drainage had best be accomplished through a vaginal cystotomy wound well above the region of the fistula. Such cystotomy wounds tend to close as soon as the catheter

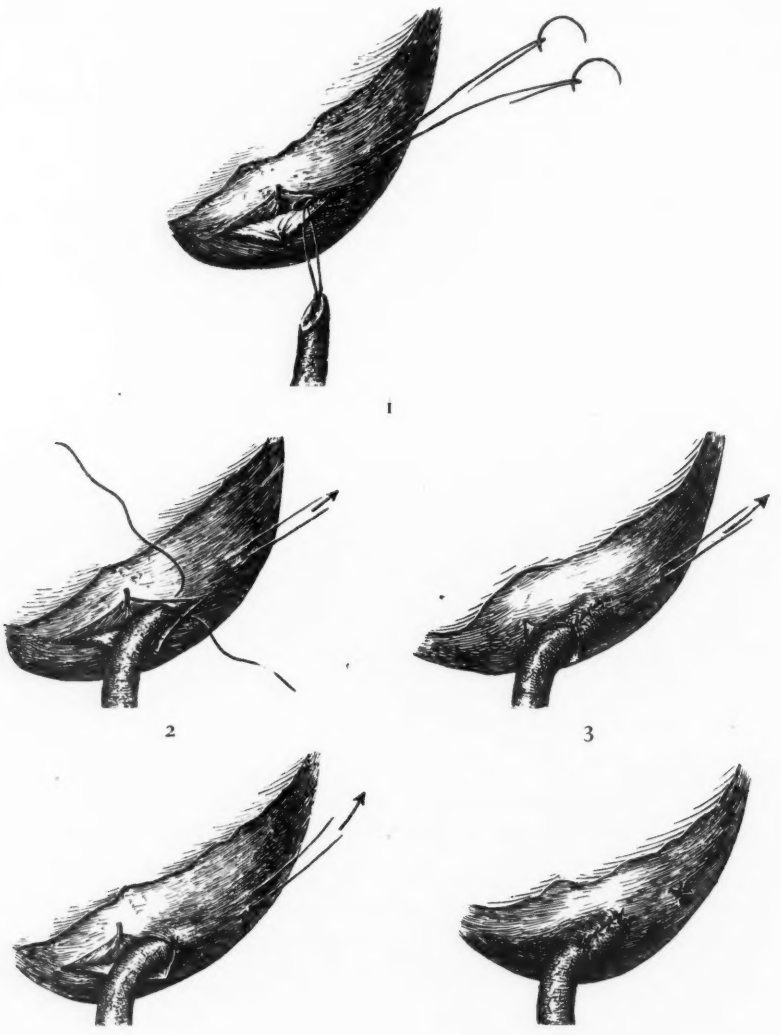


FIG. 24. Method of making the submucous ureterovesical anastomosis. 2, 3 and 4 should show the stay suture as already tied. (From Hunner and Everett. *J. A. M. A.*, 95: 327, 1930.)

is removed even without suture. Except in those cases where vaginal cystotomy is performed the suture line is best protected against urine during the early days of healing by having the patient remain in the prone position.

Ureterovaginal and Ureterocervical Fistulae. These fistulae are somewhat rarer than vesical fistulae and result usually from injury to one or both ureters during the course of gynecologic operations. The operations most frequently responsible are complete hysterectomy and those for removal of extensive adnexal inflammatory masses. Newell[161] in a study of 2,634 hysterectomies found injury to one or both ureters in fourteen of the cases. Patton[167] reported thirty cases of ureteral injury in a period of two years at Barnes Hospital, sixteen of which resulted in ureterovaginal fistulae. The operations had been complete hysterectomy (three for carcinoma) in eleven cases, and removal of diseased adnexae in four cases. The injury may be encountered in one of the following ways: (1) complete or marginal ligation of the ureter with subsequent sloughing; (2) crushing with forceps; (3) extensive stripping and interference with the blood supply followed by sloughing; (4) incision and partial division of the ureter; (5) complete division of the ureter, and (6) resection of a portion of the ureter.

Symptoms. The postoperative course of the patient in whom ureteral injury has occurred is usually stormy, but as the operations in which such accidents happen are usually of the most difficult type, such an eventuality is to be expected irrespective of ureteral injury. Of Patton's cases seven experienced renal pain without unusual fever, two unusual fever without renal pain, while in four neither of these symptoms was present. The type of postoperative course was not known in three who had been operated upon elsewhere. In ten patients in whom it was determined, the onset of urinary leakage varied from four to twenty-one days following operation. Unless there are fistulae from both ureters which is extremely rare, the leakage is generally described as continuous and uninfluenced by posture, while the patient also voids normally.

Diagnosis. These fistulae must be differentiated from very small vesicovaginal fistulae, and this can be done easily by instilling into the bladder a weak solution of methylene blue as described above. The side involved may be suspected from the difficulties of the operation and the opening into the vagina will usually be found on the side of the ureter involved, but neither of these rules can be safely relied upon as was true in a case cited by Kelly and Burnam.[121] In a case reported by Hunner and the author,[97] no particular difficulties had been encountered in the original operation, but an injury to the right ureter, as it passed beneath the infundibulopelvic ligament, resulted

in a fistula which established a channel within the broad ligament and drained through the cervix. Cystoscopic examination will usually reveal the orifice of the uninjured ureter spurting normally, while no

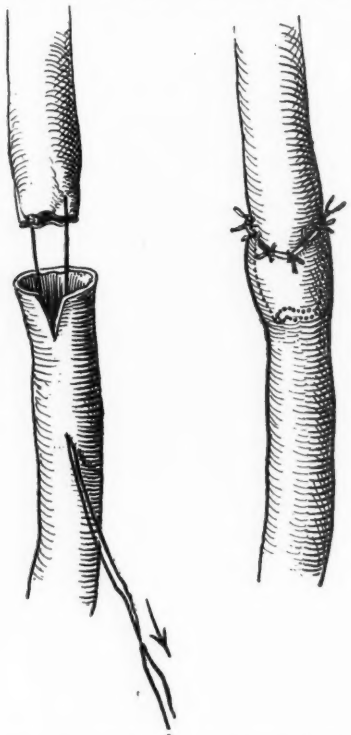


FIG. 25. End-to-end anastomosis of cut ureter. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.) If such anastomoses as well as ureterovesical anastomoses are performed over an ureteral catheter, free drainage is insured during the phase of postoperative edema.

urine can be seen coming from the orifice of the injured one. The normal ureter can be catheterized with ease, while an impassable stricture is usually encountered just below the fistula in the injured one.

Treatment. The surgical correction of ureteral fistulae is not easy and every care should be taken in performing gynecologic operations to avoid ureteral injury which may lead to occlusion or fistula. If such an injury occurs unavoidably and is recognized at the

time, repair should be undertaken at once. If the ureter has been severed but both ends are recognizable and intact, an end-to-end anastomosis should be performed over a catheter. If a portion of the lower segment has been removed, as may easily happen in removal of badly indurated inflammatory masses, the end of the upper segment should be reimplanted into the bladder. If this procedure is impossible because of the poor condition of the patient or the wide gap between the ureter and bladder, the ureter may be brought out through the abdominal wall or ligated. In Patton's[167] cases the interval between the original operation and the investigation for the purpose of treatment varied from sixteen days to six years. In the cases neglected for long periods before investigation, it is quite frequently found that severe or complete loss of renal function has occurred on the affected side. In such an event, if the function of the uninvolved kidney is normal or shows compensation for the loss of its mate, nephrectomy is the treatment of choice and of course relieves the incontinence. If the condition of the kidney warrants it, every effort should be made to save it. If, as is usually not the case, a catheter can be passed through the bladder into the ureter to a point beyond the fistula, the catheter should be left in place and occasionally the fistula will heal over it. If the ureter has been completely severed at operation, it is usually difficult to find the lower segment at the time of attempted repair. If the injury has not resulted in complete severing of the ureter, the lower segment is often so densely strictured as to offer insurmountable difficulties in dilating it originally and keeping it open subsequently, as was true of the case reported by Hunner and Everett.[97] The treatment of choice, therefore, usually is to reimplant the ureter into the bladder. Kelly and Burnam recommend that this be done when possible extraperitoneally through an incision about six inches long in the semilunar line directly over the pelvis. The ureter should be implanted as near the base of the bladder as possible to prevent future displacements of the ureterovesical orifice by the repeated filling of the bladder. The ureter should be led through the bladder wall diagonally, seeking to utilize the Coffey principle of leaving an ureterovesical valve. A large plain open end catheter, preferably a No. 9 or 10, should be introduced up to the region of the renal pelvis, and its lower end pushed out through the urethra. This makes the performance of the operation easier, it insures good renal drainage during the period of healing, and most important of all it splints the tissues of the uretero-

vesical region during the healing period and prevents the formation of obstructive angulations. If the kidney is already infected, frequent irrigations with a mild antiseptic solution may be given. As in the

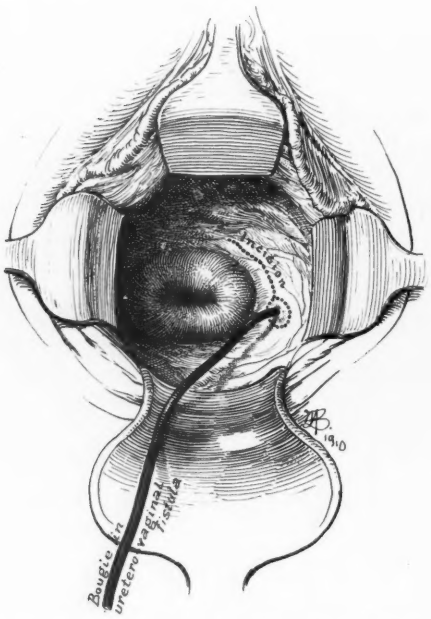


FIG. 26. Ureterovaginal fistula. I. Catheter inserted in fistula. The dotted line shows the location of the incision for dissecting out the lower end of the ureter and implanting it into the bladder. (From Kelly and Burnam. Disease of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

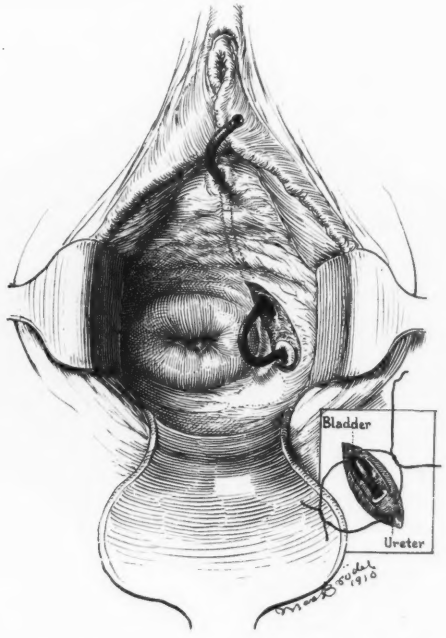


FIG. 27. Ureterovaginal fistula. II. The larger figure shows an opening in the bladder through which the free end of the catheter has been conducted and then brought out through the urethra by means of the open air speculum. The lower end of the ureter is dissected free for a little distance. It is then drawn into the bladder by means of traction sutures placed as in the smaller drawing. It is well to add another stitch or two to hold the ureter securely in place. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

case of any renal retention catheter, great care should be used to keep the bladder clean during the use of the indwelling renal catheter.

To facilitate the above operation it is well to first determine the lowest point in the bladder to which the ureter can be carried without undue tension. Then locate the position of the middle vesical artery coming up from the internal iliac so that the incision into the bladder will not molest this important blood supply. The bladder incision

should be generous, beginning in the vertex and running straight down the lateral or the posterior wall to the proposed site of anastomosis. If the functional end of the ureter is unduly short, one sometimes uses a portion of the bladder wall for a plastic lengthening of the area of anastomosis.

Patton[167] in one case drew the ureter back into the bladder through the stump of the lower ureteral segment, which he had dilated forcibly from within the bladder opened suprapubically. While this procedure has the advantage of reimplanting the ureter into the bladder at its normal site, it can be done only when the injury is very low, and even then is feasible only in those cases in which it is possible to dilate the lower segment adequately. Kelly and Burnam[121] have cited several methods of reinserting the lower end of the ureter (or ureters as in one case) through a vaginal approach, but again the application of these methods is strictly limited.

3. *Incontinence Due to Nervous System Lesions.* Disturbance of micturition due to neurological lesions occurs much more frequently in the male than in the female, 221 males to twenty-nine females in a series of 250 patients studied by Lendrum and Moersch.[138] This subject has been thoroughly covered recently in a book by Langworthy, Kolb, and Lewis,[135] and the interested reader may seek detailed information from that source. Briefly it may be stated that the effect upon the bladder is a result of the location of the neurological lesion and the nerve pathways affected rather than of the type of neurological disease. Lesions such as tabes dorsalis which affect the afferent sensory impulses from the bladder result in a loss of sensation of the desire to void, with resulting retention of urine which may eventually lead to enormous overdistention of the bladder and overflow or paradoxical incontinence. If a diagnosis is made before too great atrophy of the vesical musculature has resulted from over distention, the patient may be educated to try to empty the bladder at definite intervals in spite of the absence of desire. The tone of the bladder musculature may also be improved by the use of mecholyl bromide 0.2 gr. once or twice daily. When the motor innervation is affected as in some cases of spina-bifida occulta and multiple sclerosis, a spastic condition of the bladder musculature may result which is sufficient to produce an intravesical pressure greater than can be resisted by the urethral sphincters thus leading to incontinence. Such cases are often benefitted by the administration of tincture of belladonna and ephedrine sulfate in appropriate doses.

When there is entire absence of sphincter activity as was the case in a girl with spina-bifida reported by TeLinde,[199] some modification of the Goebel-Stoekel type of procedure may be employed with success.

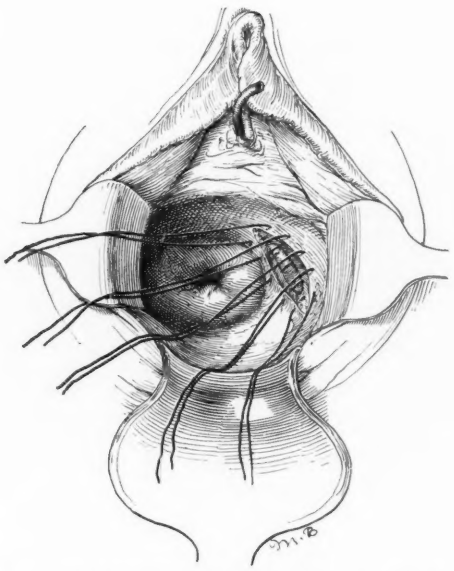


FIG. 28. Ureterovaginal fistula. III. Final step of the operation shown in the preceding figures. Closure of the vaginal wall over the freed ureter by interrupted sutures. The ureteral catheter may be left in place with advantage for several days. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

4. *Ureterointestinal Anastomosis.* In cases of exstrophy of the bladder and of traumatic defects of the urethra, bladder, or both in which the defects are of such extent that little hope can be entertained of successful plastic repair, resort may be had to transplantation of the ureters into the rectum. The history of the efforts of various investigators to find a reasonably safe and satisfactory method of accomplishing this purpose, beginning with Simon in 1851, and culminating with Coffey's[18] oblique submucous transplantation with inlying catheters has been reviewed thoroughly by Hunner and Massey[99] in 1930, and will not be repeated here. Later in operating upon small children for exstrophy of the bladder, Coffey[19,20] abandoned the inlying catheters and substituted a method by which a

transfixion suture was passed through the ureteral wall and bowel mucosa, which in two or three days sloughed through establishing a communication between the ureter and the lumen of the bowel. With the earlier methods the operative mortality was unduly high and later complications numerous; and although many successful cases have been reported treated by the Coffey technics, subsequent recurring episodes of pyelitis and pyelonephritis are the rule rather than the exception, so that in contemplating the advisability of accepting such a procedure the patient is placed in the quandary of Hamlet as to "Whether it is better to bear those ills she has or to fly to others that she knows not of."

The gravest immediate danger is that of peritonitis from contamination when the bowel is opened; but although, with a reasonably meticulous technic a peritonitis of serious extent can usually be avoided, the inflammatory reaction in the bowel wall around the implanted segment of ureter, necessarily following the immediate opening of the bowel lumen at the time of the transplant, certainly must interfere with the proper subsequent function of this ureteral segment.

Thus the inflammatory reaction in and around the ureteral segment may result in a dense stricture or a rigidity of the wall which interferes with its normal peristalsis, and prevents the collapsibility essential for a valve like action to prevent regurgitation. Quite recently Jewett[102] has devised and carried out successfully on experimental animals a technic which obviates this difficulty. Although sufficient time has not yet elapsed to evaluate the late results of this procedure, the immediate result upon patients has been entirely satisfactory. Jewett has kindly consented to the reproduction of his illustrations, and his description of the technic is stated so clearly and concisely that it will be quoted in full:

"The implantation is made in 2 stages. At the first operation the abdomen is opened through a left rectus incision under ether anesthesia. The small intestines are packed off exposing the sigmoid and the ureters, which lie beneath the posterior peritoneum. The peritoneum over each ureter is incised and the opening enlarged above and below, so as to allow each ureter to be laid without tension or angulation along the corresponding antero-lateral side of the sigmoid for a distance of 5 cm. A longitudinal incision 5 cm. in length is then made through the muscularis on each side of the sigmoid along this line which has been selected for the site of implantation. With smooth forceps the incised edges of the muscularis are

picked up and gently peeled away from the underlying submucosa for about 1 cm. Each ureter is then laid in its bed upon the submucosa. The edges of the muscularis are approximated snugly over it with a continuous suture of

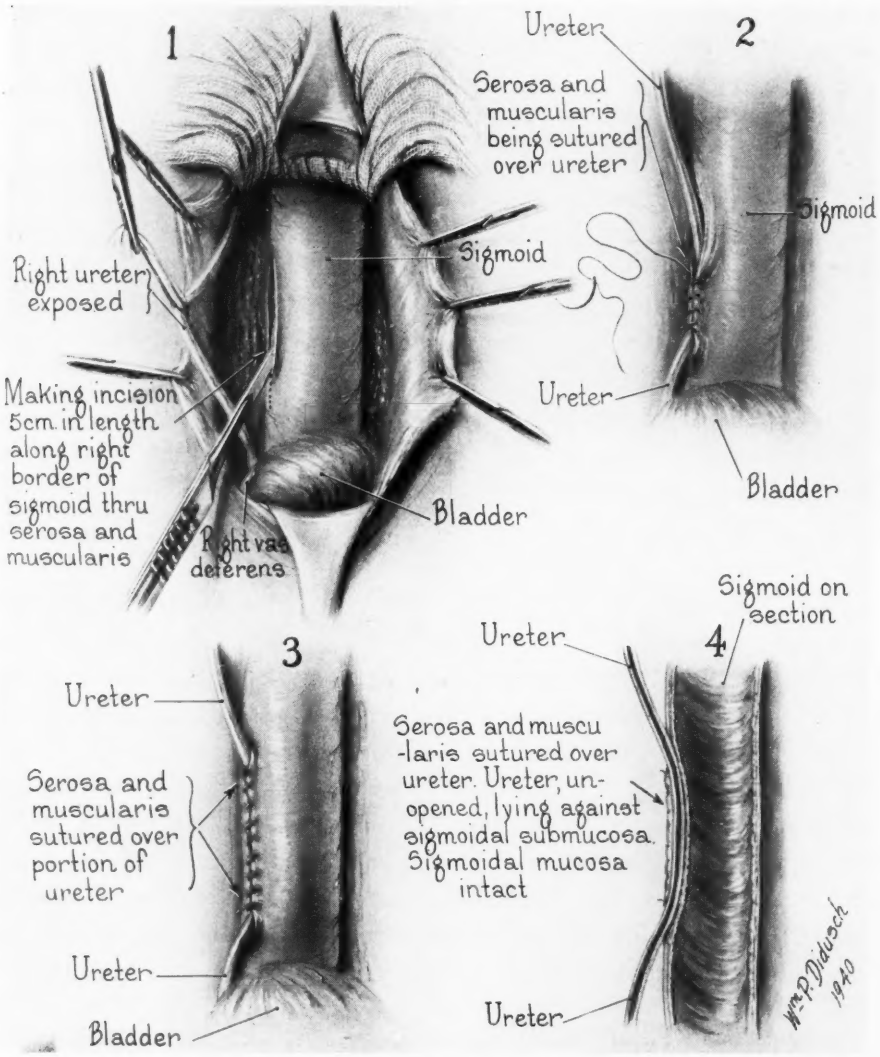


FIG. 29. Uretero-intestinal anastomosis, first stage. Ureters are laid in an aseptic bed without angulation, torsion or tension. Intramural periureteral fibrosis is reduced to a minimum, eliminating constriction and ensuring a collapsible valve. (From Jewett, H. J. *J. Urol.*, 44: 223, 1940.)

fine black silk, care being taken not to compress the ureter, especially at its point of entrance. The packs are then removed, the omentum drawn down over the suture line, and the wound closed.

"Two weeks are allowed to elapse before the second operation. During this time the dog voids urine normally from the bladder and each incision

in the sigmoid heals over the implanted segment of the ureter with a minimum of scarring, because infection is entirely excluded. An efficiently functioning valve is thereby ensured.

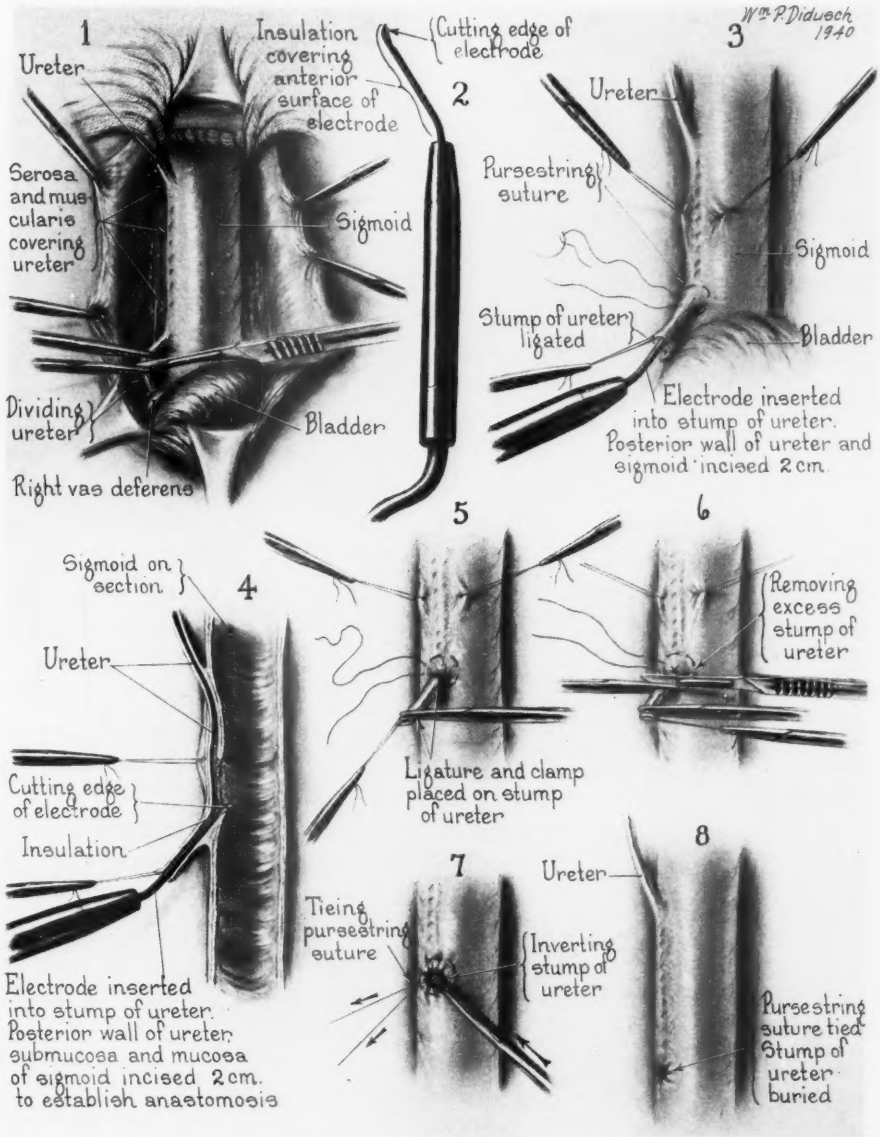


FIG. 30. Uretero-intestinal anastomosis, second stage (after two weeks.) Establishing a widely patent uretero-intestinal orifice. Its opposing margins do not reunite and constriction does not occur if anterior ureteral wall is shielded from cutting current by insulated electrode. There is no soiling. (From Jewett, H. J. *J. Urol.*, 44: 223, 1940.)

"At the second operation the abdomen is opened through a midline or right rectus incision. Delicate adhesions between sigmoid and bladder or

small intestines are separated and the latter packed off. The ureter on each side is identified entering and emerging from its bed in the wall of the sigmoid. The left ureter is divided between clamps 2 cm. from its point of exit from the bowel, and the lower end ligated. A purse-string suture of fine black silk is placed in the wall of the bowel around the emerging ureter. Two traction sutures are inserted in the muscularis of the sigmoid on each side of the implanted ureter, half-way between its points of entrance and exit. Gauze packs are then placed around the base of the emerging ureter, the clamp is removed from its end, and a traction suture taken through its lip. The electrode, ingeniously constructed by Dr. Wilford A. Councill, is now inserted in the ureter and passed halfway up its intramural segment. Its tip is depressed while counter traction is afforded by the 2 traction sutures. The cutting current is then turned on and the blade of the knife is pushed into the lumen of the bowel and carried downward for a distance of 2 cm. The current is turned off, and as the knife is withdrawn a clamp is applied to the open end of the ureter. The emerging segment of the ureter is now amputated between a ligature, placed close to the bowel, and a second clamp. The stump is now inverted through the purse-string suture. The same procedure then is carried out on the right side, the omentum drawn down, and the wound closed.

"Ferguson (1931) first conceived the idea of establishing in cadavers a ureterosigmoidal ostium by means of a fulgurating needle passed up the lumen of the ureter. This procedure in a somewhat modified form was carried out on dogs by Douglass and Edwards (1936) who were unable to complete an anastomosis which remained competent. They observed also a high incidence of associated localized infection, and therefore abandoned the method.

"I cannot overemphasize the importance of applying the cutting current to only the posterior ureteral wall and the underlying intestinal submucosa and mucosa. A wide ureteral orifice is then obtained. If the anterior wall of the implanted portion of the ureter is allowed to be burned, the newly formed ureteral orifice becomes contracted, and the overlying bowel wall may become necrotic. Therefore, the electrode used in these experiments has been so designed that the insulation covers the entire anterior margin of the blade and thereby affords complete protection to the anterior ureteral wall."

In the occasional case with a marked prolapse of the uterus and a severe bladder and urethral defect, the ureters with buttons of bladder wall may be transplanted into the rectum transvaginally and extraperitoneally as was done in one case by Hunner.[96]

V. RETENTION OF URINE

Complete retention of urine or large amounts of residual urine are rare in the female except as a postoperative complication. As has

been discussed in some detail above urethral stricture of sufficiently small caliber to produce retention is rare, and the condition of fibrosis or contracture of the vesical neck requiring resection as emphasized

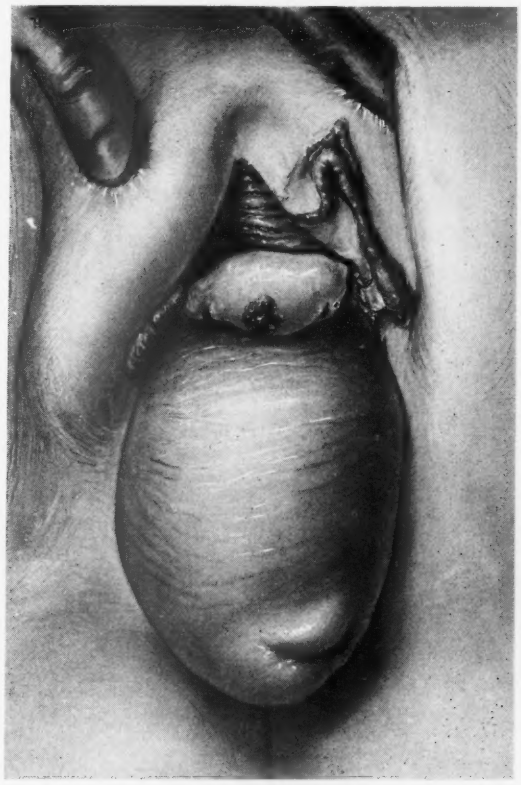


FIG. 31. Complete procidenture; vesicovaginal fistula, with prolapsing vesical mucosa and ureteral orifices; total absence of urethra; laceration through right labium minus with retraction of clitoris and prepuce toward left. (From Hunner, Guy L. *J. Urol.*, 39: 343, 1938.)

by Caulk must be even rarer. The treatment of such cases naturally consists in removal of the obstruction by dilatation of the stricture or resection of the contracted vesical neck. Retention of neurogenic origin such as is frequently found in patients afflicted with tabes dorsalis has been referred to previously. Patients suffering from various types of psychiatric conditions, particularly those of an hysterical type may often experience an inhibition of micturition, a fact which should be kept particularly in mind by gynecologists if they would avoid the embarrassment of mistaking a full bladder for a pregnant uterus or an ovarian cyst.

Other causes which may be cited as occasionally producing acute retention are a variety of conditions which may obstruct the urethra

by pressure from without. Among such conditions may be listed pelvic abscess, uterine myomas, suburethral abscess and diverticulum, and a few cases have been reported (Snodgrass,[188] Lazarus,[136] Mouradian[158]) of acute retention in girls of pubertal age resulting from imperforate hymen with hematocolpos. Two cases of acute retention complicating large uterine myomas have recently been observed by the author in a series of one hundred patients with various gynecologic conditions studied with particular reference to possible urologic complications. A few days ago a patient appeared in the clinic with acute retention, in whom pelvic examination revealed a retroverted uterus about ten weeks pregnant, in the anterior wall of which there was a myomatous nodule about 8 cm. in diameter. The acute retention in this patient had developed when the patient delayed voiding for some time after the desire had been first experienced. The distended bladder impinging upon the anterior surface of the enlarged retroverted uterus had caused further backward rotation of the fundus and consequent forward rotation of the cervix against the base of the urethra. The author has encountered one other similar case in which a spinster in her late forties had experienced several episodes of acute retention over a period of two years. In each instance the retention had followed a failure to relieve the desire to void when it was first experienced. The uterus was deeply retroverted and the tip of the cervix lay close to the vesical neck. The mechanics of the production of retention seemed evident, but it was difficult to explain why such episodes had not occurred earlier, until operation revealed a myomatous nodule in the anterior surface of the uterus which could not be felt on vaginal examination because of the extreme retroversion.

The treatment in such cases consists of relief of retention by catheterization and correction of the precipitating cause by appropriate measures. If infection of the bladder has occurred as a result of the retention, it should be treated by methods which will be discussed later in connection with the subject of inflammations of the bladder.

Of much more frequent occurrence than complete retention is the presence of varying amounts of residual urine in association with cystocele and uterine prolapse. In these cases there is usually no obstruction to the escape of urine from the bladder; but a considerable portion of the bladder hangs below the level of the vesical orifice, and the lack of support is so great that the bladder musculature is unable to expel the urine from this dependant sac. Occasionally acute

retention may occur as a complication of procidenture, but in such instances the patient usually can void following manual replacement of the prolapsed uterus. These patients with residual urine are

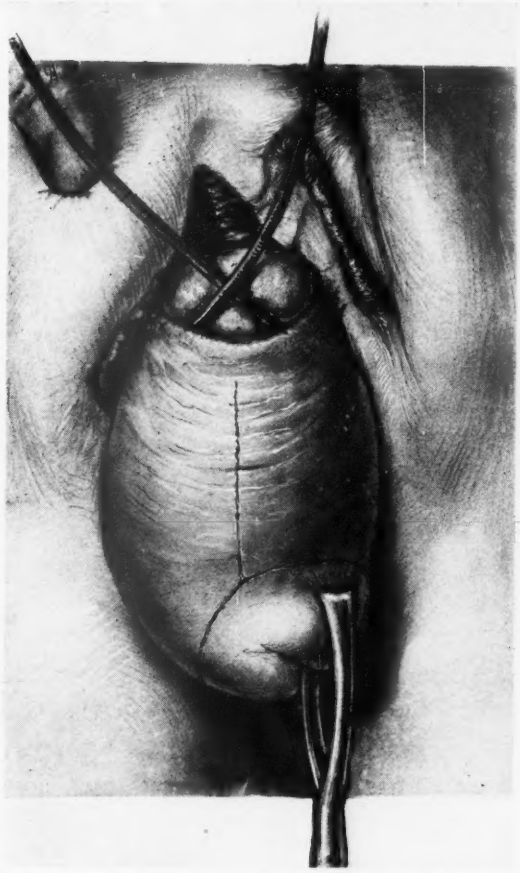


FIG. 32. Indwelling catheters introduced into ureters. Usual inverted "T" incision preliminary to vaginal hysterectomy. (From Hunner, Guy L. *J. Urol.*, 39: 343, 1938.)

particularly subject to urinary tract infection. Six of fourteen patients with cystocele, or 43 per cent, in a series studied by Everett and Sturgis[43] showed infected bladder urine as compared with 26 per cent of such infection in the total group of one hundred patients suffering from a variety of gynecologic conditions. The incidence of retention following operations for these conditions is high, 58 per cent in a recent study reported by Woodruff and TeLinde,[221] so that it is highly important that every effort should be made to eradicate the infection before operation is undertaken. In order to do this the deformity should be temporarily corrected by means of a pessary.

The residual urine will thus be eliminated, and the infection will usually yield to some form of appropriate chemotherapy.

Retention of urine as a postoperative complication is very common following gynecologic surgery. Woodruff and TeLinde[221] found an incidence 51 per cent in a series of 257 pelvic laparotomies in a hospital in which no special measures had been taken to prevent retention, and an incidence of 58 per cent following vaginal plastic operations in each of two groups, one of fifty-seven patients in whom the same preventive measures had been employed as had achieved notable success in patients subjected to laparotomy, and a control group of sixty-two patients in whom no such measures had been used. Such retention also not infrequently follows parturition, particularly if the delivery has been operative.

As such retention greatly increases the liability of cystitis and adds to the patient's postoperative discomfort, every effort should be made to combat it. In 1925, a routine was adopted on the gynecologic service of the Johns Hopkins Hospital which has greatly reduced the incidence of postoperative retention. Before the patient leaves the operating table 30 cc. of 0.5 per cent aqueous solution of mercurochrome is instilled into the bladder, and a liter of 2 per cent sodium bicarbonate solution containing 60 cc. of liquid petrolatum are administered by rectum. This routine was instituted under the direction of R. G. Craig[24] who reported the early results and who believed that the mercurochrome caused a chemical irritation of the bladder resulting in an earlier desire to void, and that the rectal fluid resulted in a more rapid excretion of urine with an earlier filling of the bladder. Woodruff and TeLinde[221] have recently reported on 500 patients subjected to pelvic laparotomy treated in this way with an incidence of only 6.5 per cent who required catheterization, as compared with 51 per cent in a control series of 257 patients. They concluded that the bladder instillation was of primary importance rather than the rectal fluid, since in a series of fifty-four patients in whom the bladder had been instilled but the fluids omitted, only 5.6 per cent required catheterization. As evidence that the bladder was more completely emptied following this treatment than in the control series, it was found that the average time of the first voiding following operation was five and one-half hours, while in the control series it was nine and one-half hours. The average amount of the first voiding was 194 cc. as compared with 168 cc. after nearly twice the time in the control series. Postoperative urinary infection occurred in

only two of the 500 patients, and in both of these there was a history of such infection previously.

As stated above, no such decrease in the incidence of necessary

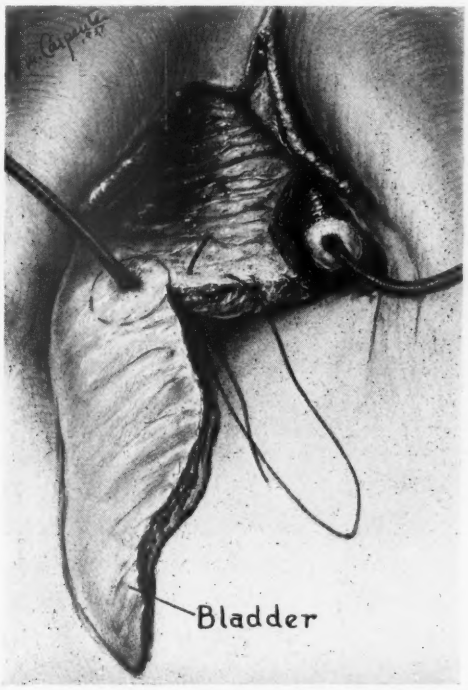


FIG. 33. Hysterectomy completed. Bladder bisected and left half already removed, leaving button of vesical mucosa about ureteral orifice. (From Hunner, Guy L. *J. Urol.*, 39: 343, 1938.)

catheterization was found to result from this treatment in patients subjected to vaginal plastic operations, and indeed it was found that following the Watkins interposition operation 72 per cent of the patients required catheterization. The authors, therefore, suggested the use of an indwelling male catheter in this type of case for the first week following operation. Kretzschmar and Brown[133] have also advocated the use of the indwelling catheter, connected with a reservoir of irrigating solution, in such a way that drainage or irrigation can be instituted as desired without change of apparatus. They suggest a 0.25 per cent solution of acetic acid as the irrigating fluid as this gives a pH of 3, considerably lower than can be tolerated by any of the usual offending organisms.

The advisability of the use of the indwelling catheter is open to question. The three objectives to be achieved in the treatment of

these cases are prevention of overdistention of the bladder, the prevention of residual urine and the prevention of infection. The first two of these objectives is certainly achieved by the indwelling catheter, but 25 per cent of the patients thus treated by Kretzschmar and Brown[133] developed infected urine, and figures pertaining to this are not stated by Woodruff and TeLinde.[221] Curtis[28] employing a routine of repeated catheterization, practically eliminated postoperative urinary infections in a large series of cases reported as long ago as 1918. In my own experience, which I believe agrees with that of Curtis, it is of primary importance that catheterizations be repeated frequently enough to prevent overdistention of the bladder, and that to achieve this the sensation of bladder fullness on the part of the patient should be used as an indication, rather than that catheterization be repeated after any certain number of hours. When after several catheterizations the patient begins to void, she will usually not be able to empty her bladder completely at first. It is, therefore, important that catheterization be continued at least once a day until only a very few cc. of residual urine are obtained. This rule should also be applied after the removal of an indwelling catheter. When repeated catheterization is necessary, or if an indwelling catheter is used 30 cc. of some mild antiseptic solution, 0.5 per cent mercurochrome or 1:1000 silver nitrate solution, should be instilled into the bladder once a day. When catheterization is required over a period of several days, or particularly if an indwelling catheter is used the oral administration of 6 to 12 Gm. of ammonium mandellate daily will often prove efficient as a prophylactic measure against infection. With the indwelling catheter the acidification of the urine, thus achieved, is often helpful in the prevention of encrustations and the clogging of the catheter by urinary sediment. If the reduction in residual urine appears unduly slow, it can often be hastened by the oral administration twice daily of 0.2 Gm. of mecholyl bromide (acetylbetamethylcholine bromide). Indeed this drug or doryl (carbaminolcholine chloride) may at times be effective in eliminating the necessity of catheterization or at least shortening the period over which it is required.

VI. DISEASES OF THE BLADDER

The bladder being an organ common to and essentially of the same character in both sexes, most of the diseases to which it is subject are of much the same character in both the male and female.

In the case of tuberculosis and primary neoplasms, this is true with regard to all aspects of the conditions, and these subjects are so adequately covered in all standard works on urology and the general

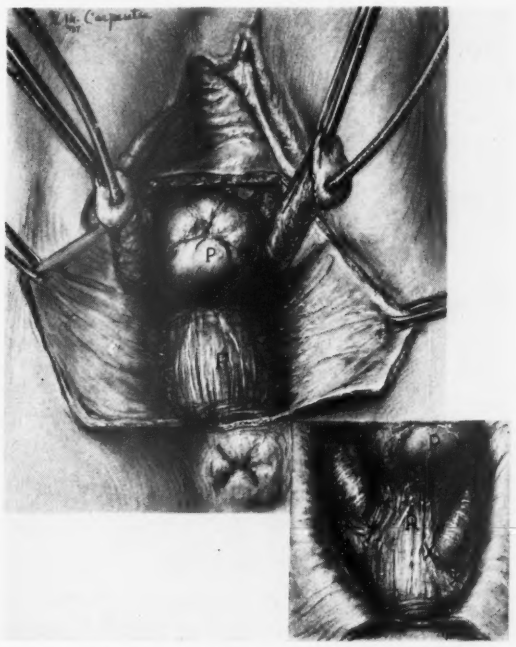


FIG. 34. Ureters have been mobilized; peritoneum has been closed with a purse-string suture which included round and utero-ovarian ligaments; posterior wall of vagina incised and drawn aside to expose anterior wall of rectum. Smaller insert: Ureterovesical buttons have been drawn into rectum and superficially placed fixation sutures of 40 day, No. 00 catgut have been set. (From Hunner, Guy L. *J. Urol.*, 39: 343, 1938.)

literature, that no special treatment is called for in an article such as this, devoted to those features of urology peculiar to the female. Other conditions, however, particularly inflammations of the commoner bacterial varieties, as well as some special forms, and secondary neoplasms entail certain variations as to incidence, etiology, etc., which distinguish them somewhat in the female from similar conditions in the male, and therefore call for at least a brief consideration.

1. *Common Inflammations.* It is the author's impression that cystitis, or inflammation of the bladder, resulting from invasion by the more usual types of organisms, occurs considerably more frequently in the female than in the male. No accurate statistical data

upon this point has been found for adults, but among admissions to the Harriet Lane Home (The Pediatric Department of the Johns Hopkins Hospital) urinary tract infections have been noted nine times as frequently in girls as in boys. The most ready explanation of this fact seems to lie in the shortness of the female urethra, with its less efficient sphincter mechanism, and its meatus lying in a field constantly contaminated by colon bacilli and other offending organisms. If then some circumstances occur which tend to decrease the normally high resistance to infection of the bladder mucous membrane the basis of a cystitis is established. In the child such lowered resistance is probably usually the result of some systemic condition such as malnutrition, digestive disturbances or respiratory infections, but in the adult female pathologic processes in the neighboring genital organs frequently offer a more readily recognized cause of lowered resistance in the bladder. Ormond[165] states that autopsy studies show a low grade inflammatory reaction in the trigone of most female bladders, even though no clinical evidence of urinary tract disease may have been observed during life, and that similar lesions are usually not found at autopsy in the male. In a recent preoperative study of the urinary tracts of one hundred patients to determine the effects of various gynecologic conditions Everett and Sturgis[43] found infected bladder urine in 26 per cent. Among the various types of conditions the highest incidence of infected urine (35.3 per cent) was found in the group of seventeen patients with cystocele with or without varying degrees of prolapse of the uterus. In this group were four patients with complete procidentia in two of whom (50 per cent) the bladder urine was infected. A group of forty-seven patients with uterine myomas showed 30 per cent infected bladder urine, while surprisingly enough in twenty-eight patients with pelvic inflammatory disease, ranging from chronic salpingitis to pelvic abscess, the bladder urine was infected in only 14.3 per cent.

The bacteria which may be responsible for the production of cystitis and more extensive urinary tract infections commonly are members of the colon bacillus group and staphylococci, and less frequently, various forms of streptococci, enterococci, Bacillus pyocyanesis, Bacillus proteus, and gonococci. The bladder mucous membrane in its normal state is usually highly resistant to most of these organisms, as is evidenced by the rarity of infection following catheterization in order to obtain uncontaminated specimens of

urine, a common practice among gynecologists. It is true that such catheterizations are carried out with as nearly sterile technic as possible, but it is generally admitted that it is probably impossible to

FIG. 35. Location of multiple minute ulcers (Hunner) on the right vertex, and the surrounding edema area found at operation. (From Hunner, Guy L. *J. A. M. A.*, 70: 203, 1918.)

rid the meatus and lower urethra completely of all bacteria. On the other hand, when catheterization has to be repeated in the presence of residual urine or a recently traumatized bladder, as in patients with postoperative retention, the most rigid prophylactic measures often fail to prevent the development of cystitis. Such considerations as this have led most urologists to believe that cystitis as a primary entity occurs but rarely, and that the term should be condemned as a diagnosis and used only to designate a symptom complex consisting of painful and frequent urination associated with pus in the

urine. This symptom complex of course does indicate an inflammation of the bladder, but in most instances careful examination of the patient will reveal that this inflammation is secondary to some more serious though less overtly symptomatic lesion. The all too common practice among practitioners and internists of hastily diagnosing cystitis on the basis of the above symptoms, and directing treatment toward relieving the bladder condition alone, is not only usually attended by failure in its purpose, but subjects the patients to the dangers of delay in the diagnosing and treating of more serious lesions. In a group of eighty-seven female patients with cystitis at the Massachusetts General Hospital carefully analyzed by G. G. Smith,[186] 61 per cent showed pyelonephritis, 19 per cent renal tuberculosis, and 20 per cent either a local obstruction or a pelvic or systemic infection, so that in not a single case could the cystitis be considered as primary.

In spite of such considerations, however, most of us who have dealt with urologic conditions in the female, have encountered a not inconsiderable number of patients suffering from so-called simple acute cystitis, in whom no associated lesions of any moment or consequence could be demonstrated by the most careful methods of examination. Such attacks may occur in association with pelvic congestion incidental to a menstrual period, or following abnormally violent or frequent coitus (so-called honeymoon cystitis) or as a sequelum of the mildest types of respiratory infection. The generally recognized fact, that such a condition of apparently primary simple cystitis is encountered almost exclusively in females, would suggest that these attacks result from ascending urethral infection, by the mechanism described above. Attacks of cystitis of this type are usually of short duration and tend to yield readily and quickly to simple forms of therapy. The failure so to respond to therapy should tend to remove a case from this category, and lead to further search, both in general examination and more especially in local examination of the pelvis and urinary tract, for the primary cause of the infection. The presence of conditions of the genital organs such as prolapse and cystocele, large pelvic tumors, and pelvic inflammations render a patient more susceptible to such attacks of cystitis, and recurrences will tend to follow in more or less rapid succession, despite successful treatment of the individual attacks, until such pelvic conditions are corrected. As stated previously, however, if the correction of the pelvic lesion involves operative

procedures, it is highly important, if possible that the urine be rendered sterile before operation in order to forestall more serious urinary tract infections during the postoperative convalescence.

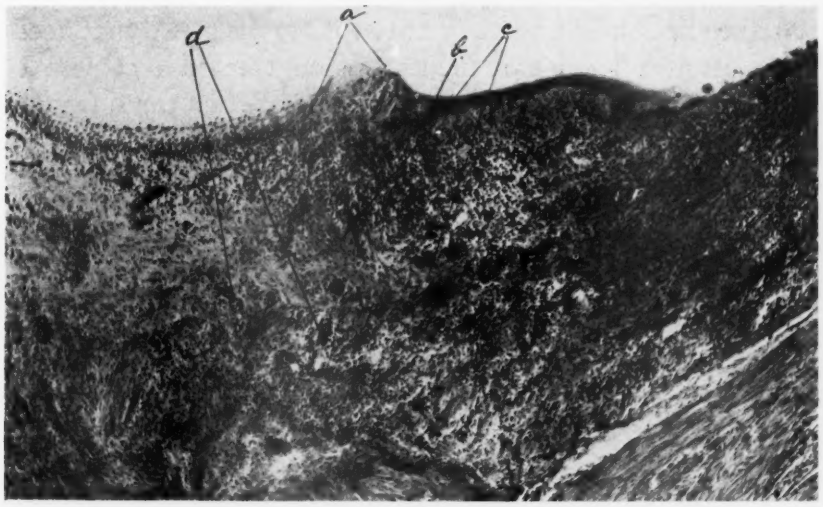


FIG. 36. Low power photomicrograph through an area of interstitial cystitis (Hunner Ulcer): *a*, gradual fading of the transitional epithelium; *b*, ulcer area made up largely of blood vessels; *c*, muscles in mucosa layer; *d*, blood vessels packed with leucocytes even in the deeper layer of mucosa. (From Hunner, Guy L. *J. A. M. A.*, 70: 203, 1918.)

The onset of such an attack is usually sudden. The symptoms are marked frequency and urgency and painful urination. The urine contains much pus and in the earlier stages usually some red blood cells also can be found. Occasionally the haematuria is sufficient to be observed grossly. Fever is usually absent if the bladder alone is involved.

Before treatment is instituted a careful history should be obtained and a careful physical examination including vaginal and rectal examinations should be performed in an attempt to discover any contributory etiologic factors. If such factors are discovered, they should be treated by appropriate measures if possible along with the treatment of cystitis. Cystoscopic examination during the acute stages is unnecessarily painful, and therefore apt to be unsatisfactory. It should be deferred until the acute symptoms have subsided, or until their failure to subside under appropriate treatment seems to indicate that the primary source of the trouble has not been discovered, and therefore must be sought more carefully by complete examination of the urinary tract. Until very recently

the unsatisfactory status of chemotherapy made it necessary to treat such conditions with irrigations and instillations of the bladder with mild antiseptic solutions. In the past few years the discovery of the usefulness of the salts of mandellic acid and sulfanilamide and its related compounds as urinary antiseptics, has greatly reduced the necessity of such local treatments. When treated by these older methods complete cure of even the mildest of such cases frequently could not be achieved in less than a month. If chemotherapy is effective at all, its purpose will usually be accomplished in a week or less. For the severer types of urinary tract infections, particularly if the upper tracts are involved the sulfa-drugs have been found to be more efficient than mandellic acid, so that recently there has been some tendency to discard the latter altogether. In the type of case under discussion, however, the author has found it most useful. The offending organism in these cases of simple acute cystitis is usually either the colon bacillus or staphylococcus, both of which are susceptible to this form of therapy. While the drug is unpleasant to take and usually produces mild disagreeable symptoms such as headache, dizziness and occasionally nausea and vomiting, it never produces severe toxic reactions such as sometimes result from the administration of sulfanilamide. Twelve Grams of either the ammonium or calcium salt should be given daily, the fluid intake should be reduced so that no more than a liter of urine will be excreted daily, and the common alkaline ash producing foods should be eliminated from the diet during the period of medication. In order that the drug may be effective the pH of the urine must be reduced to 5.5 or lower. This usually is accomplished by the third day without other medication, but failing in this ammonium chloride should be given in addition. The medication should be continued for a week, when, if the condition is really one of simple acute cystitis due either to colon bacilli or staphylococci, all symptoms will have subsided and the urine will be clear microscopically and sterile. If symptoms and pyuria should persist for more than three to four weeks in spite of adequate treatment, complete urologic study of the urinary tract should be made.

Chronic cystitis is characterized by the persistence over a longer period of time of symptoms similar to but usually less severe than those encountered in the acute condition. Such chronic inflammations of the bladder are rarely if ever primary, and their satisfactory treatment, therefore, usually entails the search for, location of, and

final elimination of the primary contributing cause. As the procedures necessary to accomplish this purpose may sometimes require considerable time, some symptomatic relief may often be given the

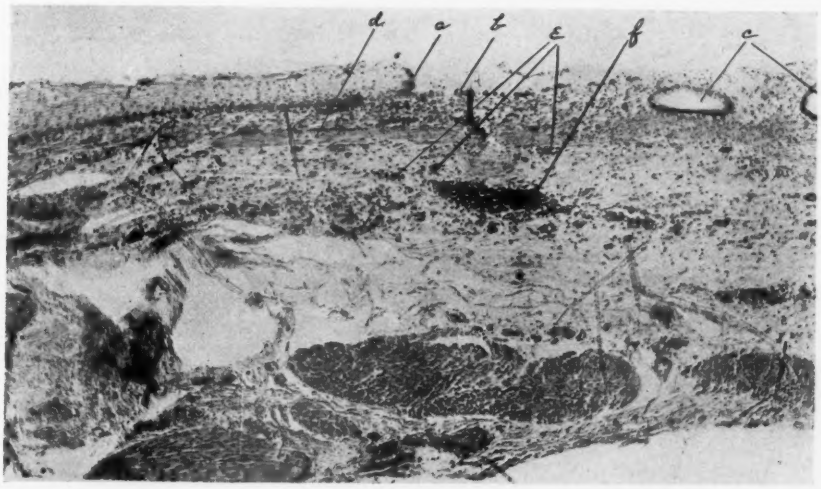


FIG. 37. Low power photomicrograph through an area of interstitial cystitis (Hunner Ulcer): *a*, abrupt ending of stratified epithelium at edge of healing ulcer; *b*, single layer of cuboidal cells; attempt at repair over the healing area; *c*, so-called cysts or glands, with mucous or goblet cell lining; *d*, smooth muscle in mucosa layer; *e*, blood vessels filled with leucocytes; *f*, collection of small round cells and leucocytes. General rarefaction due to edema. (From Hunner, Guy L. *J. A. M. A.*, 70: 203, 1918.)

patient in the meantime by local treatment of the bladder. Such treatment usually should consist of irrigations of some mildly antiseptic and soothing solution such as 2 per cent boric acid, each of which should be followed by an instillation of 30 cc. of some more potent antiseptic. For the latter purpose various drugs such as mercurochrome 0.5 to 1 per cent solution, organic silver compounds, merthiolate 1–2000, and silver nitrate 1–1000 or 1–500 may be used. The irrigations and instillations may be given daily, but three times a week is usually sufficient in the chronic cases. Before the advent of the more effective chemotherapeutic agents now available, such measures also constituted the chief means of treating acute cystitis. In the chronic cases the relief given by such treatment will almost certainly be temporary and of brief duration unless the primary cause is located and eliminated.

If the contributing cause should prove to be a lesion of the genital organs, such as cystocele, uterine prolapse, or pelvic inflammatory disease, it will usually be discovered quickly; and when the cystitis is

dependent solely on such conditions, chemotherapy is apt to be effective, provided the pelvic lesions are treated appropriately at the same time. Where such factors as foreign body or tumor in the bladder exist, they are apt to be discovered early because the persistence of severe symptoms and particularly hematuria, in spite of ordinarily adequate conservative treatment, leads one soon to suspect that something more serious than a simple cystitis exists, and cystoscopic examination of the bladder alone reveals the obvious complicating lesion. Such cases are of relatively rare incidence, however, as compared with the great group of chronic urinary tract infections where the chronic cystitis is secondary to infection in the upper tracts. It is these cases that are most apt to be wrongly diagnosed by internists and practitioners, because of the fact that in many instances the symptomatology seems entirely limited to the bladder.

In examining a case of chronic cystitis associated with chronic upper tract infection, we usually find that the urethra is somewhat infiltrated and will accommodate easily only a No. 7 or 8 Hegar dilator as compared with the No. 10 which can be easily passed into the normal urethra. In most cases the mucous membrane of the bladder appears for the most part very nearly normal, except for some dilatation of the submucosal vessels. In the more intense cases, however, there may be diffuse reddening of the whole mucous membrane which in places may be ulcerated and covered with fibrin. In such intense cases the bladder usually requires some palliative treatment with irrigations and instillations before the ureters can be catheterized. More frequently, however, such an intense cystitis is not found, but rather what in a reality is a chronic trigonitis, in which the mucosa of the trigone appears thickened and opaque and often shows minute elevations giving it a rough granular appearance. If the upper tract infection is unilateral, this trigonitis is apt to be more marked on the side of the offending kidney, and a zone of few millimeters wide around the ureteral orifice may appear brilliantly red. Having made these observations in the bladder the ureters should be catheterized and microscopic and bacteriologic studies made of the individual kidney urines. The individual function of the two kidneys should then be determined, and finally plain *x*-rays, pyelograms, and pyeloureterograms should be made. These studies should result in an accurate diagnosis of the condition of the upper tract and upon this basis rational treatment can be instituted. If

renal stones, functionless pyonephrosis or renal tuberculosis are found to exist, the appropriate surgical measures should be instituted for the elimination of these lesions, and this having been accom-

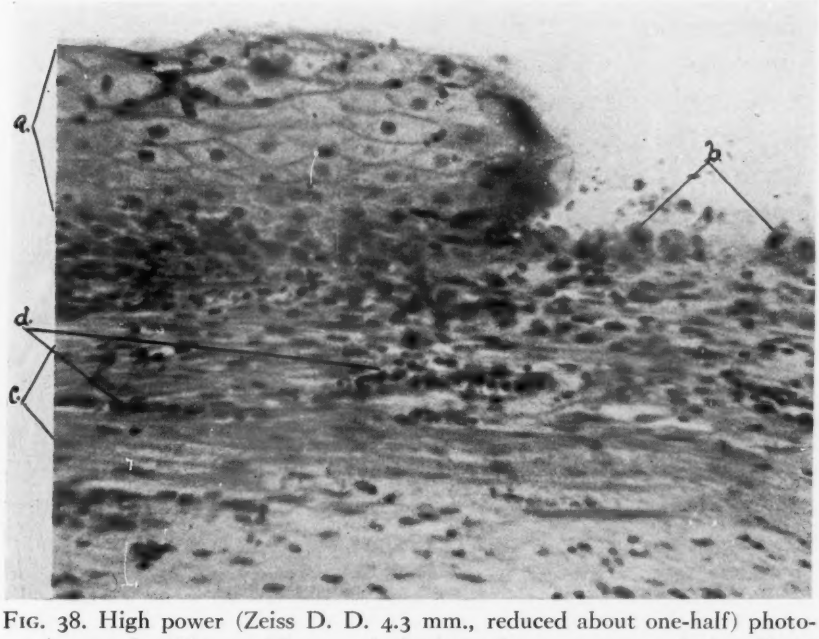


FIG. 38. High power (Zeiss D. D. 4.3 mm., reduced about one-half) photomicrograph of Hunner Ulcer: *a*, the horizontal arrangement and "hornified" appearance of the epithelial cells; *b*, single cuboidal layer over healing area; *c*, muscle cells of the mucosa layer; *d*, capillaries filled with leucocytes. (From Hunner, Guy L. *J. A. M. A.*, 70: 203, 1918.)

plished, the bladder inflammation will tend to subside spontaneously. Far more frequently, however, a low-grade chronic pyelitis or pyelonephritis will be found, probably originally caused and subsequently maintained by interference with adequate drainage. The causes of such interference with drainage may be found outside of or within the urinary tract. Among the former may be mentioned pressure upon the ureter from a pregnant uterus or tumors of the pelvic or other abdominal viscera, or an aberrant artery to the lower pole of the kidney, and dense scarring in the broad ligament regions as a result of pelvic inflammatory disease or irradiation of the pelvic viscera. Within the urinary tract we find such lesions as congenital or acquired intrinsic stricture of the ureter, abnormal angles at the pelvi-ureteral junction, and kinking of the ureter due to ptosis of the kidney. Of all the causes of such inadequate renal drainage, in our experience by far the most common is acquired intrinsic stricture of

the ureter, and the most satisfactory method of treating this lesion is by dilating the ureter through a Kelly cystoscope with wax bulbs molded upon ureteral catheters, or in cases with extremely dense strictures, with graduated bougies. The elimination of most of the other causes mentioned requires some appropriate surgical procedure.

In our experience with mandellic acid and sulfanilamide, we have found that while these drugs in proper doses will decrease the intensity of the infection and in some cases even procure sterile urine, the infection will quickly recur and return to its former intensity unless the cause of inadequate drainage has first been eliminated. On the other hand we have found that infection will often completely disappear without the aid of chemotherapy when adequate drainage has been satisfactorily established. Probably the most satisfactory procedure for the treatment of this group consists of first establishing adequate drainage by means of ureteral dilatations or appropriate surgery; and if after this infection still persists, a course of the proper chemotherapeutic agent.

2. *Interstitial Cystitis (Elusive Ulcer; Hunner Ulcer).* This condition was probably first described as "interstitial cystitis" by Skene, and in 1907 Nitze[163] (Lehrbuch der Kystoscopie) used the term "parenchymatous cystitis." These earlier works, however, dealt little with pathology and offered no solution to the problem of relieving the distressing symptoms. To Hunner, a gynecologist, is due all credit for the first systematic description of the condition and for suggesting effective methods of treatment. Hunner's[69] first publication (1914) was entitled "A Rare Type of Bladder Ulcer in Women with a Report of Eight Cases." He predicted, however, that with careful search the condition would be found also in men, and this proved to be the case as later reported by Kretschner,[127,128,130] Geraghty,[52] Bumpus,[10] Frontz,[48] and others. According to Ormond,[166] however, it occurs three to four times as frequently in women as in men. For this reason and because of the important contributions that gynecologists, particularly Hunner,[69,70,72,73,91] and Keene[109,110] have made to the subject it is one of particular interest to the specialist in female urology. It has been described under various names. In addition to those already cited may be mentioned "paracystitis" (Geraghty), "Submucous ulcer" (Bumpus), and "panmural ulcerative cystitis" (Keene). It was in 1918 at the suggestion of Cullen that Hunner[73] first used the term "elusive ulcer" as suggestive of the difficulties sometimes encountered in seeing the lesion

cystoscopically, the fact that the lesion is often missed, and the fact that the lesion visible by cystoscopic examination is usually quite misleading as to the extent of the whole disease process. John G.

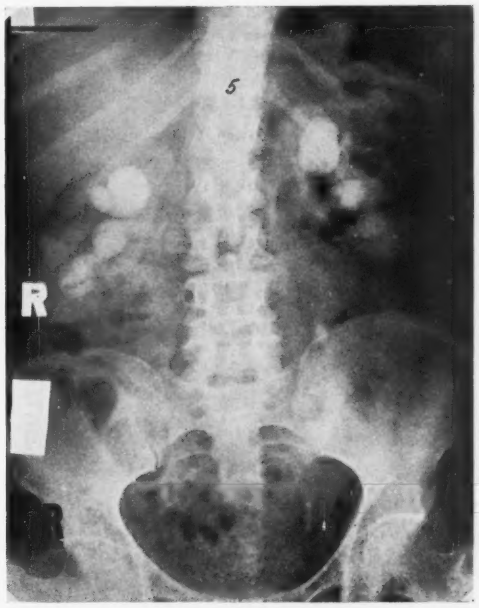


FIG. 39. Thirty-three minute intravenous pyelograms made three years after treatment with 2600 mc. hr. of radium emanations for stage III carcinoma of the uterine cervix. At the time of this examination the patient had been suffering for more than a year from an intense ulcerative cystitis with encrustations, which prevented location and catheterization of the ureteral orifices. Note the marked bilateral hydronephrosis. Plates taken earlier than thirty-three minutes following injection of diodrast showed very poor visualization. The patient developed a vesicovaginal fistula four years and seven months after irradiation and died of uremia one month later. Complete autopsy failed to reveal any remaining carcinoma. (From Everett, H. S. *Am. J. Obst. & Gynec.*, 38: 889, 1939.)

Clark[17] objected to this term and suggested that "Hunner ulcer" be substituted. These two and "interstitial cystitis" are the terms most frequently used today.

The etiology of the condition is still not entirely settled. Hunner has believed since his second contribution that distant foci of infec-

tion in tonsils, paranasal sinuses or at the roots of teeth are probably the most important factors, and in an analysis of 127 cases he found sixty with associated ureteral strictures which he believes also usually result from focal infection. Meisser and Bumpus[152] enthusiastically championed this theory and were able to demonstrate a selective affinity for the urinary tract in animals on the part of streptococci isolated from foci of infection in patients suffering from such lesions. Keene[110] could find no demonstrable focal infections in some of his patients and could see no benefit from their elimination when found, but from the pathologic character of the lesion he believed that it was of hematogenous origin either embolic or toxic. The possibility of tuberculosis as a factor was carefully considered by Hunner, Keene, and others and eliminated on both bacteriologic and histologic grounds. Any association between parity or conditions of the pelvic organs has also been excluded. Keene was of the opinion that a latent or recurrent renal infection might be the etiologic basis, but admitted that in the majority of instances the demonstration of such lesions was lacking. The condition has been described as beginning at almost all ages from early youth on, and in Hunner's first twenty-five cases the average age at onset of symptoms was twenty-five years.

Pathology. Careful descriptions of the lesions have been made by most of those who have contributed to the subject, but Hunner's original description has hardly been improved upon and may be quoted in full:

"The histologic study of specimens removed at operation shows a fairly uniform picture in all cases. It is a picture of chronic inflammation involving all coats of the bladder and extending over the wide area which at operation shows oedematous thickening. At the site of the minute ulcer there is loss of the epithelial coat and the underlying mucosa shows the granulation tissue characteristic of active ulcer. Other sections taken from what appears to be an ulcer in the gross specimen show an abrupt ending of the epithelial layer at the edge of an area that is evidently undergoing healing, and here the mucosa layer is less richly supplied with capillaries, and is much like the mucosa beneath the epithelial covering, showing a preponderance of connective tissue and infiltration of round cells and leucocytes. Such a healing area may be covered by a single layer of cuboidal cells.

"The mucosa layer in the neighborhood of the ulcer shows an increase in the number and size of the capillaries, varying in different specimens. The capillaries are often stuffed with leucocytes as are many of the lymph spaces. There is an appearance of hyaline degeneration in some areas, and in some of the sections the oedema causes rarefication.

"The muscularis mucosae seems to be hypertrophied in most of the specimens. The muscle coat shows enlarged lymph spaces filled with small round cells; these spaces as well as some of the blood vessels of the muscle

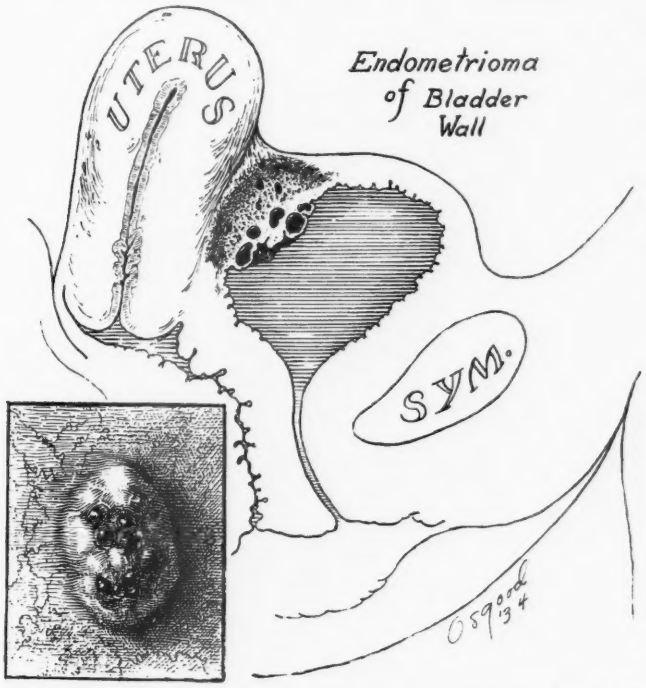


FIG. 40. Endometriosis of bladder. Diagrammatic sketch of bladder tumor in relation to the uterus. Inset: Gross appearance of tumor with the characteristic bluish cysts on the surface. The bladder mucosa about the tumor is injected and thickened. (From Henriksen, E. *J. A. M. A.*, 104: 1401, 1935.)

coat, contain many leucocytes. Immediately beneath the ulcer, the muscle in places shows invasion and breaking up by the inflammatory process. The peritoneum, subtending a diseased area shows decided thickening."

Symptoms. The disease is characterized by its chronicity and by the extreme severity of symptoms referred to the bladder with relatively little to be found on examination of the urine. Hunner states that the chief symptom is pain associated with which other symptoms of cystitis occur in varying degree, namely, frequently day and night, strangury, burning and smarting. "The pain is often of the most extreme grade, the patient complaining of a jabbing or stabbing knifelike pain, or of a sensation of a jagged, sharp stick in the bladder." The pain may be referred to the perineum, vulva, suprapubic regions, along the course of the ureters, to the rectum, or down the

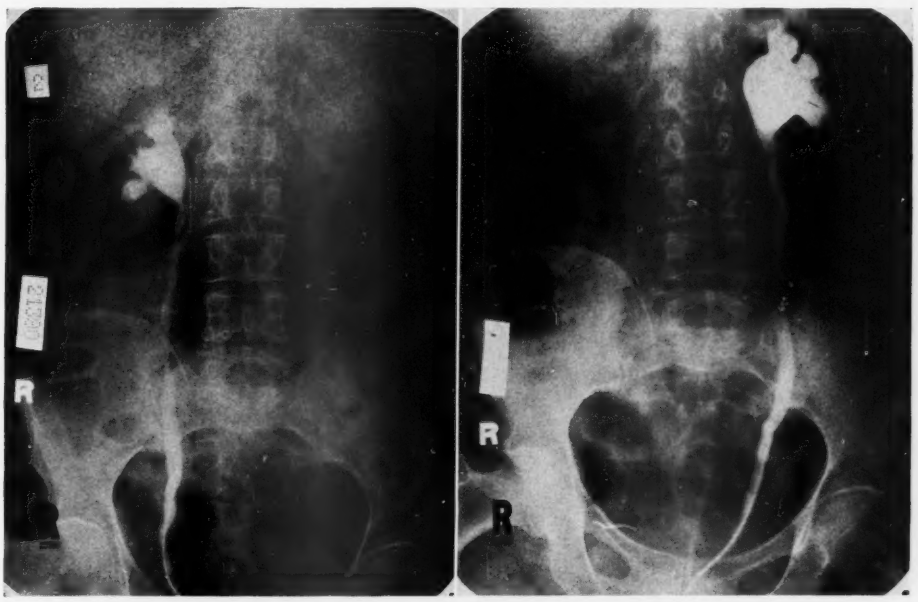
thighs. It is aggravated by walking, coitus or intestinal peristalsis. The severity of the pain with the loss of sleep resulting from the marked frequency often leads to complete nervous exhaustion. In Hunner's first twenty-five patients an average of ten years had elapsed since the onset of symptoms before the correct diagnosis was made, and many of them had been subjected to multiple surgical procedures without relief.

Diagnosis. With a history of symptoms such as have just been outlined, if the urine is grossly clear and shows only an occasional leucocyte and erythrocyte microscopically in the centrifugalized specimen, and is sterile on culture the condition should be suspected at once. If, as stated by Hunner, Geraghty and Ormond, slight distention of the bladder causes severe pain, and the slight distention is followed by terminal hematuria the diagnosis is almost certain. As with the urine examination, cystoscopy reveals remarkably little in view of the severity of the symptoms. The bladder, as a rule, is markedly contracted due to spasm and either a general anesthetic or prolonged local anesthesia from an instillation of 15 to 30 cc. of nypercaine (Ciba) 1–500 solution is usually necessary for a satisfactory examination. Hunner's description of the lesion as seen through the cystoscope is quoted:

"The cystoscopic picture is remarkable because of its almost negative character in most instances. Unless one is awake to the possibility of this lesion and goes over every portion of the bladder mucosa the conclusion is easily reached that the bladder examination is negative. There may be no portion of the mucosa that can be described as an actual ulcer area. One's attention may first be arrested by the unusually white appearance of most of the mucosa, or one may first discover a scar area entirely devoid of macroscopic vessels. Such a scar area will usually present one or more slightly congested area in the immediate neighborhood, and if these are touched with an instrument or with a dry cotton pledget in the alligator forceps there will be a slight oozing of blood. In the glazed dead-white portions of the mucosa the vessels are likely to present a broken or 'choppy' appearance, only short segments of vessels appearing on the extra pale surface. There may be small or speckled areas resembling the minute plaque-like red areas seen on the vaginal portion of an eroded cervix. At times the granular points are arranged in a circle which on the dead-white background resembles the lesion of a ringworm.

"As a rule, careful examination will discover one or more actual ulcerations. These may be situated anywhere in the vertex or free portion of the bladder, but they are most frequently found high in the vertex, and on

either side near the junction of the vertex, lateral, and anterior walls. This position just back of the symphysis is the most difficult portion of the bladder wall to examine with either the Nitze or Kelly method of cystoscopy.



a *b*

FIG. 41. *a* and *b*, right and left pyeloureterograms of a white woman, aged sixty-four years, who had suffered from descensus of the uterus for eight years and complete procidentia for two years. She complained of no urinary symptoms. The prolapse was corrected surgically by Richardson's composite operation. Three months after operation pyelographic studies were repeated but showed no change from those shown here.

"These ulcer areas are always small, usually measuring not more than 5 mm. in diameter. They may be linear and measure from 0.5 to 2 cm. in length and from 1 to 2 mm. in width, and may thus resemble the mouse-eaten linear ulcer not infrequently found in a tuberculous bladder. Two or three minute ulcers may be found in a group, and they may be surrounded by a small red area of edema. The ulcers always appear to be superficial, and I have never seen them covered with necrotic membrane or urinary salts nor have I ever seen them present a picture suggesting malignancy. The bimanual palpation before cystoscopy may cause the ulcer to bleed, as may the splitting of the surface when the air distends the bladder if the patient is examined in the knee chest posture. Hence one may catheterize macroscopically clear urine at the beginning of the examination and be surprised to find bloody urine in the bladder immediately afterward on doing cystoscopy.

"The ulcer area may or may not be surrounded by a zone of radially converging vessels. One may find a minute ulcer, with or without edema,

around it and in another portion of the mucosa an edema area without an appreciable ulcer. These edema areas are generally seen immediately after the patient has been having an unusually bad period of bladder symptoms with much strangury.

FIG. 42. Bilateral pyeloureterograms of a patient with a large pseudomucinous cystadenoma of the left ovary. Note moderate dilatation of pelves, calyces and ureters above the pelvic brim. Intravenous pyelograms sixteen days following surgical removal of the tumor showed that the urinary tracts had returned to normal size.

"The full extent of the infiltrated area is rarely discovered by cystoscopy, and at operation it is outlined by the redness and edema which arise during the preliminary freeing of the bladder from its surrounding tissues."

Ormond[166] states that the condition must be differentiated from tuberculosis and from granular urethritis which usually accompanies it. Hunner[72] who also found a chronic inflammatory reaction in the urethra felt that it was probably secondary to the severe strangury as it always disappeared following operative removal of the diseased area in the bladder.

Treatment. Ormond[166] in a recent article stated that treatment should consist of local treatment of the bladder lesion, general treatment such as rest, elimination of foci of infection, and correction of

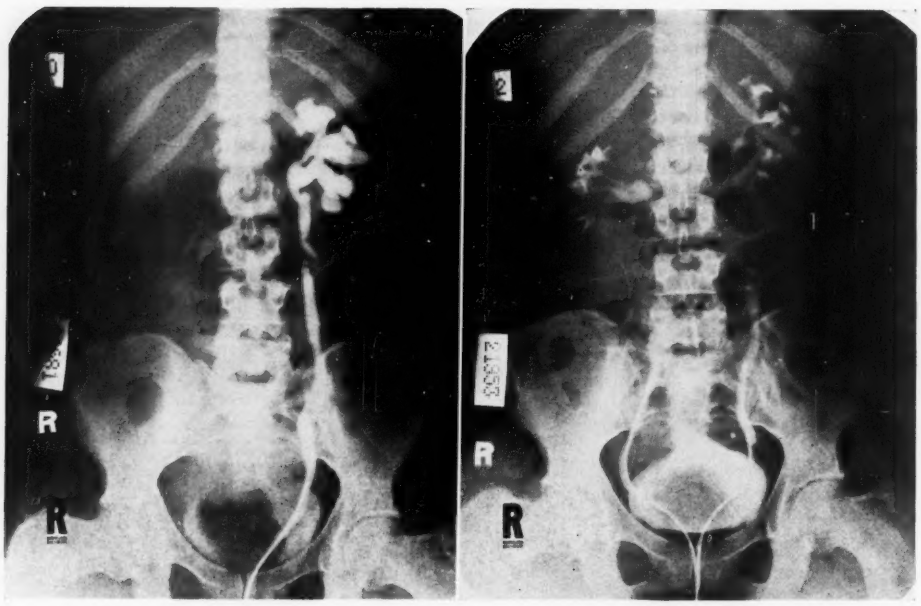
anemia, and treatment of concomitant granular urethritis by urethral dilations. He listed eight types of treatment that have been used for the local lesions as follows: (1) Distention of the bladder either rapid under anesthesia or gradual without anesthesia. The pain is usually relieved but frequency persists and the pain recurs in three to four months. (2) Irrigations and topical applications with corrosive substances such as silver nitrate and pure phenol; (3) intravenous mercurochrome; (4) ureteral dilatations; (5) fulguration; (6) excision; (7) transplantation of ureters in extensive intractable cases; and (8) Resection of presacral nerves. Little or no success had resulted from measures 3 and 8.

In the earlier reports on the subject excision was considered the treatment of choice by Hunner and most others. The pain was completely relieved, and except for moderate frequency in some cases from a reduction in the size of the bladder due to the necessity of excising a large area, the patients seemed cured. Later, however, in reviewing 127 cases, forty-eight of which had been treated by excision, Hunner[91] found recurrence in 42 per cent. Such findings as this on the part of most of those interested in the subject have greatly diminished the earlier enthusiasm for excision.

The treatment which seems to have proved most satisfactory with the test of time is first, thorough attention to the general health of the patient with elimination of all possible foci of infection; second, complete examination of the entire urinary tract with treatment of any concomitant lesions there. Hunner[91] found ureteral stricture in sixty of 127 patients and noted marked symptomatic improvement following ureteral dilatations alone; third, treatment of the diseased area in the bladder, either by fulguration or the application of such caustics as pure silver nitrate or pure carbolic acid (Sears[180]). These measures are not curative except in an occasional patient who after repeated treatment seems to obtain permanent relief. They do, however, give satisfactory relief for a time which varies from a few months to about a year after which the treatment must be repeated. The relief as a rule persists longer following fulguration than after chemical application.

3. *Neoplasms.* Primary neoplasms of the bladder occur considerably more frequently in men than in women and therefore will not be considered here. Neoplastic disease of the female genital organs, however, frequently exert a profound influence upon the bladder as well as other part of the urinary tract. In the case of

benign tumors the effect exerted upon the bladder is usually that of distortion from external pressure. In a recent study by Everett and Sturgis[43] of the effect upon the urinary tract of a variety of gyne-



a *b*

FIG. 43. *a*, dilated ureter, pelvis and calyces on the left side in a patient with a large uterine fibroid. Intravenous pyelograms had shown a normal right tract, but poor visualization of the left tract. *b*, bilateral pyelograms two months after removal of the tumor show that the left tract has reverted to almost normal proportions.

cologic conditions there were forty-seven patients with uterine myomas in 21.3 per cent of whom such distortion of the bladder was found, and in the thirty patients in whom the myomas were sufficiently large to extend above the pelvic brim, the percentage of bladder distortion was 26.6 per cent. Moreover eighteen or 38.3 per cent of these forty-seven women complained of bladder symptoms such as frequency, nocturia and dysuria, but the urine was infected in only ten or 21.3 per cent, so that the bladder discomfort must have been due to some other cause than infection. The most probable cause in this particular group would seem to have been the distortion from external pressure of the tumors, as in most of them, even those in whom the urine cultures were positive, the symptoms were relieved following removal of the fibroids. Similar findings were encountered in a smaller group of ten patients with ovarian tumors, 20 per cent of whom showed distortion of the bladder, and 30 per cent

of whom complained of bladder symptoms, although the urine was infected in only one.

Malignant tumors arising in the genitalia may also produce distortion of the bladder by external pressure or fixation, but more important still they may extend to and directly involve the bladder wall in the malignant process. Such effects may be exerted by any type of malignant pelvic tumor, but as carcinoma of the uterine cervix occurs far more frequently than all other types of genital malignancy combined, it has been subjected to more intensive study in regard to its effects upon the urinary tract than have other types of malignant neoplasms. The behavior of this type of carcinoma toward the bladder will, therefore, be taken as an example of the possible effects which may be exerted by a variety of pelvic neoplasms and will be treated in some detail.

Excellent studies of this subject have been reported by Aman-Jean[2] in France, and by Graves, Kickham, and Nathanson[55] from the Pondville Hospital in Boston, and the interested reader may refer to their articles for details and complete bibliography. In both of these articles the importance of cystoscopic examination of the bladder before, during, and after treatment as an aid to the evaluation of prognosis, the progress of the disease, and the success or failure of treatment were stressed. The Boston group recorded cystoscopic studies on 105 patients, forty-three of whom were studied before the institution of therapy, and sixty-two during or after therapy. In only sixteen of these was no effect traceable to the carcinoma observed. In fifty-three cases there were effects which could not be ascribed definitely to invasion of the bladder by the carcinoma. These were described as distortion of the bladder from extravesical pressure, termed "bombement" by Marzetti[146] and Aman-Jean;[2] trigonal edema, and both distortion and trigonal edema. The first of these effects was observed in eighteen cases, the second in twelve, and the combination of the two in twenty-three.

The distortion from extravesical pressure consists usually of a uniform elevation of the proximal trigone and posterior wall, covered with normal mucosa and unaffected by distention. The interpretation of this finding should be made with caution, and guided by the findings on vaginal examination as it may be produced by the tumor, by the reaction following irradiation, by an inflammatory process in or around the uterus, or merely by an anterior lying fundus. The fact that Korkhov[125] found by cystoscopic inspection a

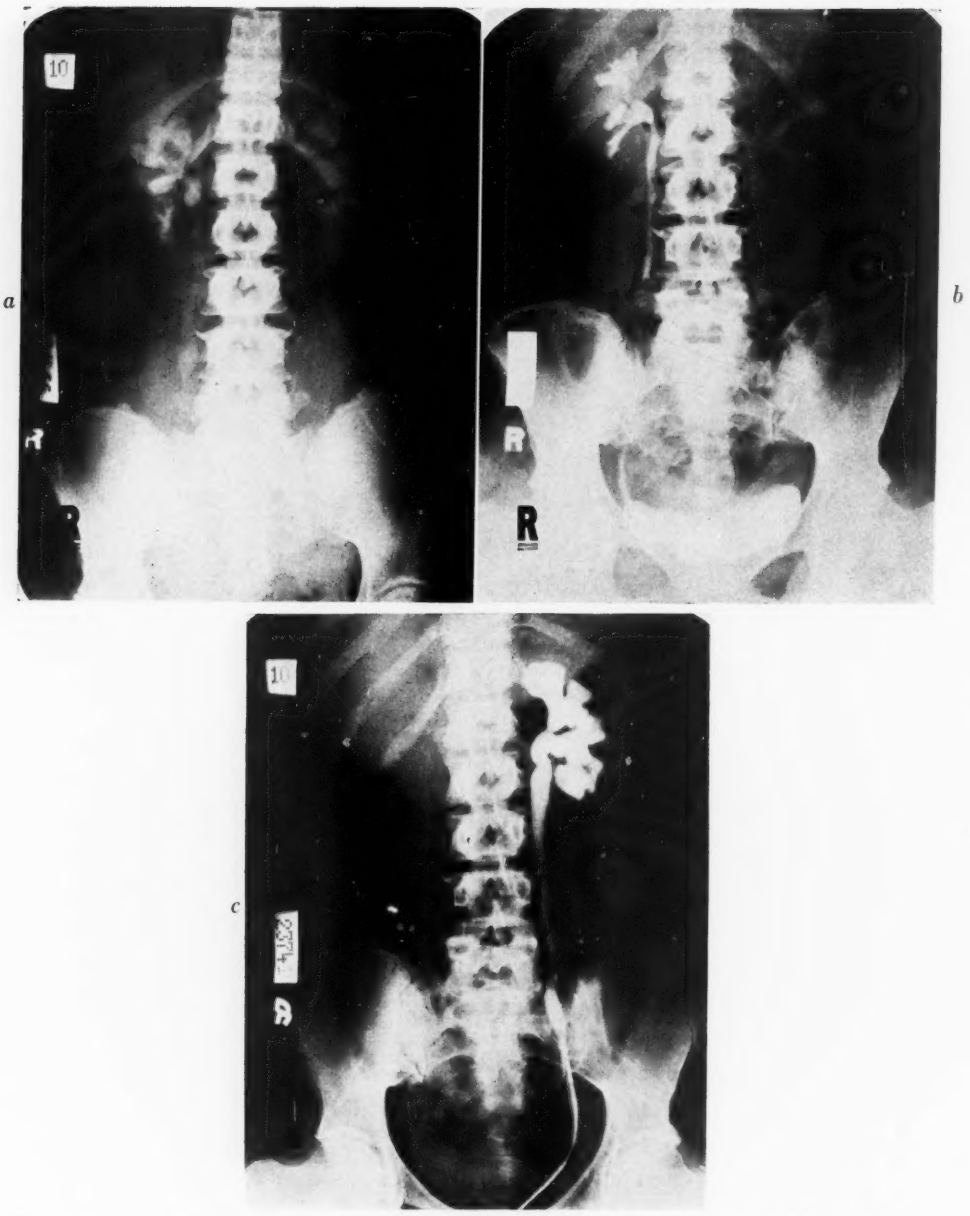


FIG. 44. *a*, one hour intravenous pyelograms before operation of a patient with a myomatous uterus extending to the costal margin, bilateral chronic salpingitis and abscess of the left ovary. Note the marked dilatation of ureters and renal pelves on both sides with poor visualization of the left tract. *b*, retrograde right pyeloureterogram two months after operation (hysterectomy and bilateral salpingo-oophorectomy) shows that the tract has returned to essentially normal proportions. *c*, retrograde left pyelogram nine months after operation shows persistent dilatation of the left tract. This was the side upon which there was an ovarian abscess which leads to speculation as to possible rôle of this more intense pelvic inflammation in producing the permanent dilatation of the urinary tract on this side.

definite improvement in the bladder outline following irradiation in fifty of one hundred cases, and that similar observations were made by Aman-Jean indicates, as stated by the latter author, that such observations may constitute a guide as to the efficacy of treatment.

Schmitz,[176] Vermooten,[210] and others believe that oedema of the bladder base probably in most instances signifies invasion of the bladder wall by carcinoma beneath the area of oedema, but Graves[55] and his associates are of the opinion that an inflammatory reaction around the tumor in a region adjacent to the bladder may also produce such a picture.

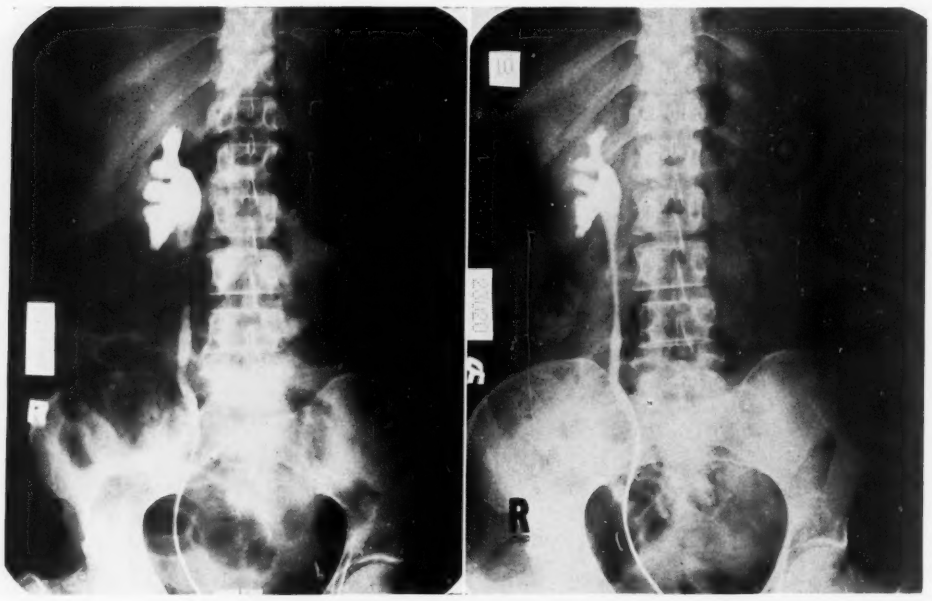
Invasion of the bladder wall by the tumor ultimately produces a submucous nodule or actual projection of the neoplasm into the bladder cavity with or without ulceration. Such was the case in twenty-three of the 105 cases studied cystoscopically by Graves and his associates. This finding definitely places a case in grade IV as regards extension, and as ten of the twenty-three patients mentioned above had been classed in grades II or III from the findings on vaginal examination, the value of cystoscopic study as an aid to classification and prognosis is readily seen.

The end stage of actual bladder involvement by cervical carcinoma is the formation of a vesicovaginal fistula, and Graves and his associates believe that most patients with actively progressive disease will eventually develop such fistulae unless death occurs sooner from hemorrhage, uremia or some other cause. They found fifty-five fistulae in 425 patients, or an incidence of 12.9 per cent and the average length of life after the appearance of the fistula was only five months. Autopsy studies by Behney,[6] Warren,[215] Williams,[220] and Faeber[44] showed incidences of vesicovaginal fistulae of 22.3 per cent, 35.3 per cent, 38 per cent, and 45.3 per cent, respectively.

Of more practical importance from the point of view of therapy than the actual invasion of the bladder by carcinoma, are those lesions which result from the treatment of carcinoma and other genital disorders by irradiation. These lesions frequently occur in patients in whom the carcinoma has been arrested or even cured, and have been described by Dean,[34,35] Newell and Crossen,[162] Smith,[187] Colby,[21] and Everett.[42] Dean who probably has given the clearest description of such conditions has mentioned three types of reaction to irradiation found in the bladder as follows:

"Primary erythema occurring within twenty-four hours after treatment and being merely a nonspecific reaction to local irritation.

"Secondary erythema appearing usually about twenty-eight days after treatment and being a specific reaction to irradiation, probably due to temporary vasodilatation.



a *b*

FIG. 45. Right pyeloureterogram of a patient with extensive pelvic cellulitis. The left side was similar to the right and there was colon bacillus infection and reduction of function on both sides. The patient was treated by transfusion, sulfanilamide and diathermy. There was marked symptomatic improvement, the urinary infection was eradicated and the function of the kidneys returned to normal. *b*, shows the change in the right urinary tract after six months. On the left side where there was some persistence of pelvic induration no such change occurred in the urinary tract.

"Tertiary reaction consisting of obliterative endarteritis with sloughing and ulceration of the tissues. These lesions are often covered with grayish slough or gritty deposits and can only be definitely distinguished from carcinomatous invasion by biopsy. They rarely appear earlier than a year and may appear as late as ten years after treatment with an average of two and one-half years."

Dean found an incidence of 2.5 per cent of such tertiary ulcerations in all patients treated and 7.3 per cent in those retreated, and Newell and Crossen found slightly more than 1 per cent. Everett,[42] in a study of only those patients in whom the carcinoma was apparently arrested or cured, found an incidence of 18 per cent, and Colby,[21] whose statistics were compiled in a similar manner reported an incidence of 34.3 per cent. The ulcerations went on to the forma-

tion of vesicovaginal fistula in two of Smith's seven cases, seven of Colby's twelve cases, and two of Everett's seven.

In one of Everett's patients who eventually developed a fistula the ulceration involved the whole of the base and trigone and was covered by a dirty membrane containing calcareous deposits. There was marked ureteral obstruction and the patient died of uremia five years after treatment of the carcinoma. Autopsy failed to reveal any evidence of remaining carcinoma.

In view of the relatively small dosage of irradiation that had been given some of these patients, Dean suggested the probability of individual susceptibility of the bladder tissues to such injury. Most of the authors are agreed that unless fistulae develop the ulcers eventually tend to heal, but that the healing process is a slow one. Various types of treatment have been suggested from simple irrigations to fulguration of the ulcer base, but all are agreed that a most important item is the avoidance of further irradiation, a procedure which may well be suggested and carried out unless the lesions are carefully differentiated by biopsy from carcinomatous invasion.

Everett found some type of bladder disturbance in approximately 55 per cent of his cases. Some showed the secondary reaction described by Dean but it usually occurred later than was observed by that author. Others showed areas in the base of the bladder in which the mucous membrane as a whole was abnormally pale but showed evidence of petechial submucosal hemorrhages. Since three patients presenting this picture later developed ulcerations, it was considered as possible evidence of an earlier phase of the ischemic process which eventually leads to ulceration.

4. *Endometriosis.* An exceedingly rare condition but one of exceptional interest to the gynecologic urologist is endometriosis of the bladder. The first case of this nature was reported in 1921 by Judd[106] and since that time perhaps forty others have been recorded. In Judd's case the condition was considered to be primary in the bladder, and Henriksen[59] in 1935 reported what he believed to be the twenty-first case belonging to this classification. Henriksen was of the opinion "that the term 'primary vesical endometriosis' should be limited to those cases in which no demonstrable contiguity with the uterus, fallopian tube or ovaries is present, and in which there has been no surgical trauma of the bladder wall or its peritoneal reflexion." In 1939, Reynolds[172] was able to collect thirty-four cases all primary. In view of the relative frequency of endometriosis involving

the genital organs and pelvic peritoneum it would seem logical to suppose that cases of bladder involvement secondary to the process in the adjacent pelvic viscera would occur more frequently. This,

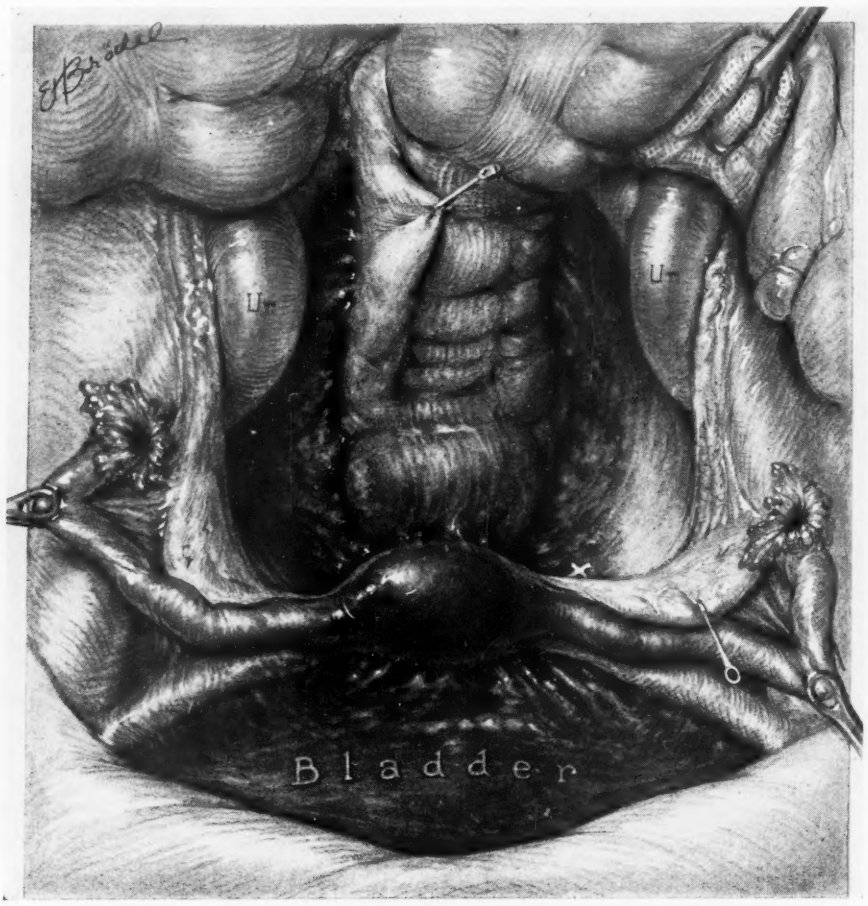


FIG. 46. Showing marked dilatation of the ureters above the pelvis and a ureteroperitoneal fistula at *x* on the left side. There was also a large vesicovaginal fistula. These developments followed eighteen months after irradiation therapy for carcinoma of the uterine cervix. Complete autopsy revealed that the carcinoma had been entirely eradicated. (From Hunner, G. L. and Everett, H. S. *J. Urol.*, 28: 333, 1932.)

however, has not proved to be the case, at least in so far as can be found in a review of the reports to the present time. Keene[111] reported two such cases in 1925 and ten years later Henriksen was able to find reports of only nine similar ones.

Most of the reports have dealt extensively with the theories of the origin of endometriosis, particularly the primary vesical type. While

such discussions are of considerable interest to the gynecologic pathologist they are of little value to the practical urologist.

The condition consists of a tumefaction in the bladder wall situated slightly above the interureteric fold in the region of the uterine prominence. If the specimen is obtained for microscopic study, it will show endometrial type glands with or without stroma embedded in a fibromuscular matrix.

The symptoms are usually gradual in their onset and consist of bladder cramps, dysuria, frequency and terminal hematuria, present only, or certainly most marked in association with the menstrual periods. Most of the recorded cases have occurred in women between the ages of thirty-five and forty-five. On cystoscopic examination the tumor appears as a sharply defined area of congestion posterior to the interureteric fold which may involve one or both ureteral orifices. Through the mucosa bluish cysts may be seen, and if there is mucosal involvement bluish translucent grape-like projections may extend into the bladder cavity. If there is involvement of an ureteral orifice, in addition to the bladder symptoms there is apt to be renal pain on the affected side at the time of the menstrual periods. The urine is usually normal except for hematuria which occurs only during menstruation.

The treatment should be varied according to conditions found in the individual case. In the primary cases if the patient is young and desires children and there is no ureteral involvement, surgical excision of the tumor should be done. If the patient is near the menopause or if there is ureteral involvement, castration by irradiation is the treatment of choice. In the secondary cases surgical castration is preferable, in that it permits attention to other foci of endometriosis at the same time. Each of these forms of treatment usually has been successful in relieving the patients of all urinary symptoms.

5. Stones and Foreign Bodies. Vesical calculi occur extremely rarely in women as compared with men except as secondary deposits around foreign bodies. Among 1,007 cases cited by Sir Henry Thompson[203] only fourteen were adult females. Among Lower's[143] series of 157 cases only nine were in females. Since as has been mentioned bladder infections occur considerably more frequently in female than in male patients, this rarity of stones in the female must be due to the low incidence of small caliber obstructions of the urethra and vesical neck. On the other hand foreign bodies introduced into the bladder by patients themselves are found considerably more fre-

quently in women than in men. Such mishaps usually result from masturbation or attempted abortion and lists comprising a great variety of objects so introduced have been compiled. Commonly found in such lists are such objects as hairpins, lead pencils, knitting needles, small wooden sticks and so on. Furthermore such objects as bits of catheters or rubber tubing may occasionally break off and be left in the bladder, or the bladder wall may be penetrated by a suture during pelvic operations. Rare cases have been recorded in which material from a dermoid cyst or fetal bones from a neglected extra-uterine pregnancy have made their way into the bladder. Stones are apt to form from the deposition of urinary salts around any such foreign body left in the bladder, and the rapidity with which this may take place is often surprising. Beginning encrustation of such an object may often be observed within a very few days from its introduction.

The symptoms of foreign body in the bladder are usually those of a severe cystitis, namely, marked frequency, urgency, pain and strangury. Pus and blood in abundance are usually present in the urine. Intermittent retention of urine may occur from blockage of the vesical neck by the stone. If such symptoms have persisted for a considerable period before the patient seeks medical aid, the introduction of a foreign body during masturbation or in attempted abortion should be suspected at once.

If the stone or foreign body is large it can be felt on vaginal examination, and often can be sounded with a glass or metal catheter. A roentgenogram of the bladder region and cystoscopic examination may be relied upon to make the diagnosis conclusive.

If the foreign body is small or elongated and of small caliber, it usually can be removed through a Kelly cystoscope with alligator forceps. Stones too large to be removed in this way may sometimes be crushed and the particles removed, or a stone only slightly larger than the lumen of the cystoscope may sometimes be grasped through the instrument and drawn out through the urethra simultaneously with removal of the cystoscope. If the stones are large and hard, or if they or portions of the foreign body around which they may have formed are embedded in the bladder wall, it is usually wiser to resort to cystotomy than to attempt removal through the urethra. In the adult parous female the simplest approach for cystotomy is through the vagina and this method usually can be used with entirely satisfactory result, unless some other lesion is suspected such as tumor or

diverticulum which requires thorough and complete exploration of the bladder. Under these circumstances suprapubic cystotomy will be found more satisfactory. With either approach if the associated cystitis is severe the bladder incision should be closed around a drainage tube and a catheter should be left in the urethra to permit thorough through-and-through irrigations.

VII. OBSTRUCTIVE LESIONS OF THE UPPER URINARY TRACTS

1. *Ureteral Obstructions Resulting from Gynecologic Lesions.* The urologic diseases of major importance which affect the kidneys are the same in both sexes, and since their surgical correction, when called for, entails the same technical principles and is fully treated in all standard works on urology, as well as in the general literature, further detailed treatment of these subjects would be superfluous. It is a well recognized fact, however, that certain diseases of the kidneys such as hydronephrosis, pyelitis, pyelonephritis, pyonephrosis, and calculi, in large measure result from some lesion producing an interference with the normal escape of urine from the renal pelves, or in other words to urinary stasis in the upper tracts. In the male the lesions responsible for such stasis are found most often at the vesical neck or in the urethra, and consist of such conditions as hypertrophy of the prostate, or small caliber stricture of the urethra. In the female, however, obstructive lesions below the bladder sufficient to produce urinary retention are extremely rare, and the etiologic basis for upper tract stasis is most frequently found in some condition which interferes with the normal conduction of urine by the ureters from the renal pelves to the bladder. In the paragraphs quoted in the introduction to this article from Kelly's[112] publication in 1888 upon palpation of the ureters, are mentioned such conditions as pressure from uterine and ovarian tumors and the gravid uterus, retroflexion and prolapse of the uterus, constriction from parametric scars, retroperitoneal sarcoma, and carcinoma of the uterus, as well as the dangers of ureteral injury during gynecologic operations for the correction of some of these and other gynecologic disorders.

Thus at this early date, before a cystoscope adequate to permit easy catheterization of the ureters and study of the upper urinary tracts had been invented, the master mind of Kelly pointed out the close relationship between gynecologic lesions and gynecologic surgery and many diseases of the upper urinary tracts. Since that time the subjects thus set forth briefly by Kelly have been elaborated

upon from time to time by many others. Concerning the effect upon the urinary tracts of some of these conditions, notably pregnancy and carcinoma of the uterine cervix, a very extensive literature has

FIG. 47. Autopsy specimen of the right kidney and upper ureter from the same case as Figure 46. The two kidneys were similar in appearance. (From Hunner, G. L. and Everett, H. S. *J. Urol.*, 28: 333, 1932.)

developed, while in regard to most of the others only an occasional article has appeared.

In 1923, Brettauer and Rubin[8] made a careful clinical study of the upper urinary tracts in eleven women, ten of whom were suffering

from prolapse of the uterus and cystocele, and one from cystocele without prolapse. In eight of the ten with prolapse and in the one without prolapse hydroureter and hydronephrosis were found. They

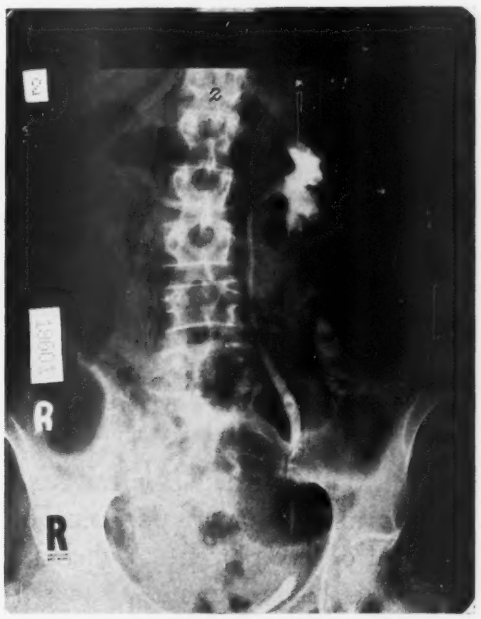


FIG. 48. Left pyeloureterogram made six months after 3,109 mc. hr. of radium emanations and 8,400 r of deep *x*-ray therapy for stage II cervical carcinoma complicated by a small uterine fibroid. Note moderate dilatation of the ureter and pelvis. Intravenous urograms taken before treatment showed normal tracts. (From Everett, H. S. *Am. J. Obst. & Gynec.*, 38: 889, 1939.)

reviewed the work of previous authors namely Tandler and Halban,[58] Froriep, and Hirakawa, all of whom had reported similar findings from studies of autopsy material. These authors, however, had all concluded that the ureteral and pelvic dilatation had resulted from compression of the lower ends of the ureters at the point of their herniation through the hiatus genitalis, while Brettauer and Rubin believed, that in the cases of uterine prolapse at least, the dilatation was due to kinking and compression of the ureters by the drag of the prolapsed uterine arteries. Wallingford[211] in 1939 reported six cases with prolapse, all of whom showed upper tract dilatation, and one of whom died of uremia resulting from the severe damage to the kidneys. From a study of this material, he came to the same conclu-

sion as to the mechanism of stasis as did Brettauer and Rubin. Kretschmer and Kanter[131] found bilateral dilatation of the ureters and pelves in only one of four patients with prolapse, but the degree of the prolapse is not stated. Everett and Sturgis[43] found one case of bilateral and one of unilateral dilatation among four patients with complete prolapse, and three cases of bilateral and one of unilateral dilatation among ten patients with partial prolapse.

In a recent study of one hundred patients to determine the effect upon the urinary tract of a variety of gynecologic disorders Everett and Sturgis[43] found bilateral dilatation of the ureters and renal pelves in 31 per cent and unilateral dilatation in 19 per cent, or some demonstrable effect in 50 per cent of the total group. The proportion of dilatation found among the various groups of gynecologic disorders represented was as follows: Large myomas (above the pelvic brim), 66.6 per cent of thirty patients; small myomas, 29.4 per cent of seventeen patients; chronic salpingitis, 44.4 per cent of nine patients; subacute salpingitis with pelvic masses, 58.3 per cent of twelve patients; pelvic abscess, 57.2 per cent of seven patients; ovarian cyst, 40 per cent of five patients; ovarian carcinoma, 60 per cent of five patients; complete procidentia, 40 per cent of four patients; incomplete uterine prolapse with cystocele, 40 per cent of ten patients. Kretschmer and Kanter[131] in a similar study limited to uterine myomas and ovarian cysts except for four patients with uterine prolapse and one with pelvic abscess, found upper tract dilatation in 62.5 per cent of twenty-four patients with large myomas, 54.5 per cent of eleven patients with small myomas, and 81.9 per cent of eleven patients with ovarian cysts. There was a return to normal following appropriate surgical procedure in 72.5 per cent of the total group. As yet only twenty-five of the fifty patients showing upper tract dilatation in the group studied by Everett and Sturgis have been restudied since completion of their gynecologic treatment. Of these twenty-five, in fourteen, or 56 per cent, the urinary tracts have returned to normal, while in eleven, or 44 per cent, some degree of dilatation has persisted. This greater incidence of persistent dilatation than was found by Kretschmer and Kanter can probably be accounted for by the inclusion in the group of patients with pelvic inflammatory conditions, in whom the removal of the masses does not eliminate entirely the periureteral and ureteral scarring, which may have resulted from the presence of the inflammatory process in the neighboring pelvic structures.

In the group studied by Everett and Sturgis there were no symptoms elicited from any of the patients which could have been definitely attributed to the abnormalities found in the upper urinary tracts, although 46 per cent of them complained of some degree of bladder discomfort. In most instances, however, this was of the mildest type. The bladder urine was infected in 26 per cent, but only 7 per cent showed infection of the upper tracts, and there was evidence of diminution in renal function in only 10 per cent. The persistence of dilatation in 44 per cent of those restudied after the completion of satisfactory gynecologic treatment, is indicative of the possibility that more serious diseases of the kidneys may occur later as a result of the processes initiated by the original gynecologic condition, and therefore indicates that the possible effect on the urinary tract should be carefully considered in every patient suffering from a major gynecologic disorder. The absence of localizing symptoms referable to the kidneys or ureters in so large a group of patients showing hydronephrosis and hydroureter, further emphasizes a fact, often pointed out by urologists, of the frequent symptomatic silence of many serious lesions of the upper tracts. In 1937, in attempting to emphasize the importance of careful urologic study of the upper urinary tracts in patients presenting persistent or recurring symptoms of cystitis, or presenting obscure diagnostic problems, the author[39] under the title "Disproportion between Symptomatology and Pathology in Urinary Tract Disease," reported ten cases, selected from among many other similar ones of his experience, as furnishing most striking illustrations of this point. Among these ten cases were included three of renal calculi associated with chronic pyelitis or pyelonephritis, two of chronic pyelonephritis without calculi, one of uninfected functionless hydronephrosis, two of renal tuberculosis, and two of malignant renal tumor. In his untiring crusade to emphasize the frequent occurrence and importance of ureteral stricture, and the protean character of the symptomatology of this disease, Hunner has time and again called to the attention of the profession at large the importance when dealing with patients presenting obscure diagnostic problems, of remembering that they possess a urinary tract, and that adequate examination of this tract will often reveal the source of the trouble when all other measures have failed. In spite of the widespread recognition of these facts on the part of urologists, however, until quite recently their importance and truth have not seemed to arouse the interest of the

medical diagnosticians. Many patients, after complete studies including roentgenograms, of most of the organic systems of the body with negative results, were consigned to the scrap-heap of functional neuroses without an examination of the urinary tract, because in the absence of pathologic findings in the urine and of symptoms pointing obviously to this system, the painful procedures of ureteral catheterization and retrograde pyelography seemed unwarranted to the physician in charge. The advent of intravenous urography, as well as the recent case reports of hypertension arising from unilateral renal disease, have done much to dispel this hesitancy on the part of our medical brethren to request urologic consultation.

The eventual encroachment upon and occlusion of the ureters, with resulting renal damage and death from uremia has long been recognized as one of the most frequent modes of exodus from untreated or uncontrolled malignant disease of the genital organs, and particularly of cervical carcinoma. Furthermore, so long as radical operations remained the chief means of treating this condition, it was also recognized that these operations more than any others entailed the risk of ureteral injury. It was not until quite recently, however, that there was any recognition of the fact that serious damage to the urinary tract might result from irradiation therapy.

The slowness with which this fact became recognized was no doubt due to the hesitancy that naturally exists, when signs of ureteral obstruction occur in a patient known to have had carcinoma, not to attribute the obstruction to persistence and spread of the carcinoma. Indeed the burden of proof does rest upon one who would claim otherwise. However, autopsy studies by Behney[6] and by Morton[157] have revealed the tremendous destructive effect upon normal tissues that may result from irradiation in some instances. Such destructive effects upon the bladder are observed frequently, and have been discussed in a previous section. In 1929, Hunner and the author[98] reported the case of a patient in whom, eighteen months after radium and roentgen therapy for cervical carcinoma, there was found a vesicovaginal fistula and almost complete obstruction of the lower ends of both ureters, with perforation of the left ureter into the peritoneal cavity, and bilateral hydroureter, hydronephrosis and pyelonephritis. The patient succumbed and autopsy failed to reveal any remaining carcinoma. A very similar case was reported by Schmitz[176] in 1930. In 1934, the author[42] reported ureteral obstructions in seventeen patients following pelvic irradiation, in three of

whom the irradiation had been administered for benign lesions, and of the fourteen in whom the irradiation had been administered for carcinoma the malignant process was apparently arrested in all but

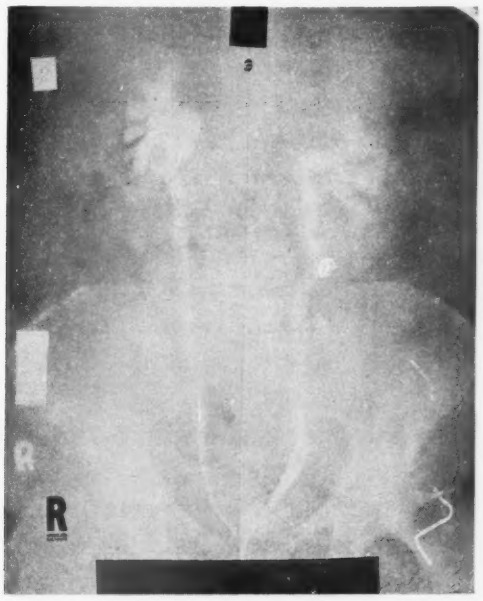


FIG. 49. Original stage II carcinoma of the cervix. Right and left pyelograms twenty months after original treatment of 2,870 mc. hr. of radium emanations, and fourteen months after a retreatment of 11,960 r of *x*-ray. (From Everett, H. S. *Am. J. Obst. & Gynec.*, 38: 889, 1939.)

two. Cases of ureteral obstruction following irradiation for benign lesions have also been reported by Bugbee[9] and by Kretschmer.[129] A very careful and detailed report of a study of the upper urinary tracts in cases of cervical carcinoma was reported in 1936 by Graves, Kickham, and Nathanson,[56] but although most of their patients had received irradiation therapy, some doubt is left as to the proportion showing urinary tract lesions in whom the disease had been arrested.

Recognizing the frequent incidence of other causes of ureteral obstruction in the female, and of ureteral stricture in particular, it occurred to the author that the frequency of obstruction resulting from irradiation therapy, and indeed its occurrence at all, could be proved only by a careful study of the same patients both before and after such therapy. Accordingly, forty-six patients with cervical carcinoma, in whom there seemed some possibility of cure, were

subjected to complete urologic study before any treatment was instituted. Sixteen of these showed evidence of upper tract damage, a finding which proved to be of grave prognostic significance as the treatment failed to effect a cure in any of them. Of the remaining thirty who showed no evidence of damage to the urinary tracts before treatment, in twenty-five the carcinoma was apparently cured or arrested, but only seventeen of these could be induced to return for further studies of the urinary tracts. Of these seventeen, six or 35.5 per cent showed evidence of ureteral obstruction. In a larger group of thirty-three patients including the seventeen studied before treatment and sixteen in whom such studies had not been made, but in all of whom the carcinoma apparently had been arrested, evidence of ureteral obstruction was found in sixteen patients or 48.4 per cent.[42] Similar studies have been reported by Howes and Strauss,[64] and more recently by Jaffe, Meigs, Graves and Kickham.[101] These latter authors stressed particularly the importance of the group of patients in whom evidence of ureteral obstruction was found at the time of institution of treatment. Their conclusion was that appropriate urologic treatment by ureteral dilatation or if necessary ureterostomy, nephrostomy, or even nephrectomy in such cases as were found to have one kidney infected and completely functionless, tended so to improve the general condition of such patients as to render them better able to withstand the effects of intensive irradiation therapy, thereby considerably increasing their chances for a longer and more comfortable survival.

In the author's study[42] it was found that the degree of ureteral obstruction and resulting hydroureter and hydronephrosis tended to be in direct proportion to the length of time which had elapsed since the completion of irradiation therapy. The lesson of practical significance to be learned from these studies is that ureteral obstruction does develop in a not inconsiderable proportion of patients salvaged from cervical carcinoma by irradiation therapy, and that these obstructive lesions are apt to be progressive and lead to serious results, unless appropriate means are instituted to detect them in their earlier stages and prevent their progress. Periodic urologic examinations, therefore, should be a part of the follow-up routine of all patients who have been subjected to irradiation therapy for cervical carcinoma or other genital lesions; and when evidence of beginning ureteral obstruction is encountered treatment by ureteral dilatations should be instituted.

2. *Stricture of the Ureter.* Though this disease entity is by no means confined to the female, Rathbun[171] in 1925 having reported the finding of the condition in forty-eight males and forty-four females among 739 patients examined in a single year, the recognition of the frequency of its occurence has resulted to a great extent, from the technical methods of examination made possible by the use of the Kelly "open-air" method of cystoscopy. Kelly[116] in 1902 was the first to call attention to the importance of ureteral stricture as the primary etiologic lesion in such conditions as pyonephrosis and hydronephrosis, and the possibility of relief of the diseased condition of the kidney, and the improvement or restoration of its function by proper attention to and treatment of the strictured ureter. However, in spite of this principle enunciated by Kelly, all urologists continued to believe that ureteral stricture was a rare lesion and usually of congenital origin. Such ureteral obstructions as were rarely and accidentally encountered in association with renal infections, and with ureteral or renal lithiasis were considered to be the result of these lesions, and secondary to them in importance until 1915, when Hunner[71] began his contributions to the subject, which in volume and enthusiasm have amounted to a veritable crusade. The subject is one still productive of much skeptical discussion, but the clear logic of Hunner's arguments, and still more important, the results that he has obtained by therapy directed along a line strictly in accordance with the principles that he has laid down, have served clearly to demonstrate the large element of truth in these principles, and to convince all but the most reactionary skeptics.

Hunner[88] has defined ureteral stricture as "an intrinsic disease of the ureteral wall resulting in narrowing of the lumen which leads to varying degrees of stasis in the urinary stream," and further states that "this narrowing may be congenital or acquired." He believes that the acquired type is by far the most frequent, and after careful consideration of various possible factors which might give rise to such acquired strictures, among which he mentions trauma, syphilis, the pressure of pelvic tumors, pelvic inflammations, and cervical carcinoma and its various forms of treatment, he finally concludes that the condition most frequently occurs as a chronic inflammatory process in the ureteral wall resulting from some distant focal infection elsewhere in the body. Space does not permit a full review of the various arguments in support of this theory, but they may be found in several of Hunner's publications[74,78,88] a bibliography of which will

be found appended. The most convincing of these arguments have been the frequent association of the disease with focal infections, a tendency of an exacerbation of the focal infection to produce an

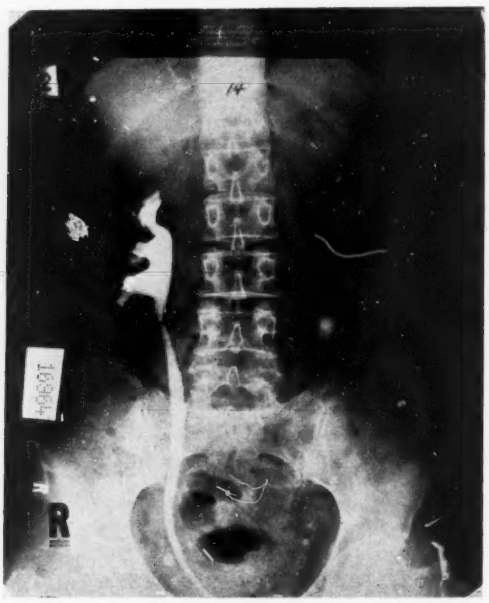


FIG. 50. Original stage III carcinoma of cervix. Right pyeloureterogram five and one-half years after first treatment with 4,500 mc. hr. of radium emanations, including gold points in the parametria. Retreatments of 1,600 mc. hr. of radium emanations and 8,640 r of *x*-ray had been given three and five years, respectively, after the original treatment. At the time of this examination there was no clinical evidence of carcinoma. Note the permanent needle in the right parametrium and note its distance from the ureter. (From Everett, H. S. *Am. J. Obst. & Gynec.*, 38: 889, 1939.)

exacerbation of symptoms due to stricture, and the failure in many instances of the stricture to respond to adequate treatment by ureteral dilatations until focal infections have been eradicated.

But little has been published regarding the pathology of these lesions, due no doubt to the fact that the strictures themselves never result fatally, until superimposed urinary tract lesions of such severity as to mask the nature of the original stricture have ensued. In a study of autopsy material from eight cases by Hunner and Wharton[100]

there were only two which could be classed as possibly due to focal infection, three being of the congenital type, and three others having resulted from operative trauma or irradiation. Perhaps the most complete and valuable anatomic study of ureteral stricture was made by Schreiber.[178] A protégé of the late Edwin Beer, Schreiber on a Daniel Guggenheim Fellowship, made this study in 1926 at the Senkenberg Pathologic Institute, University of Frankfurt-am-Main. Briefly, the object of his study was to test at the autopsy table by both anatomic and pathologic data, the conception lying behind that clinical entity which has been given the name of "ureteral stricture."

After an excellent brief review of the literature, Schreiber presents with adequate illustrations the results of his study on one hundred consecutive, unpicked autopsies comprising forty-two adult males, ages twenty-two to eighty-seven years; thirty-seven adult females, aged twenty to eighty-one; and twenty-one children, ages seventh month prenatal to fifteen years.

Hunner often has expressed the verbal opinion that in a cross section of society probably considerably less than 5 per cent of the population suffers at some time the effects of ureteral stricture; but that, if we could study at postmortem that segment of society dying in a hospital, we would probably find fully 5 per cent bearing evidences of this disease. Schreiber's studies of patients dying in a city hospital and therefore representing a cross section of the underprivileged class should show a slightly higher incidence of ureteral stricture.

Schreiber made the astonishing discovery that in his seventy-nine adults twenty-five, or about 31 per cent, presented some type of ureteral disease. In the one hundred cases (including the twenty-one children) he found twelve cases of ureteral obstruction ten due to narrowing or stenosis, and two in which he considered the hydroureteronephrosis as due to a scarring of the ureteral wall by surrounding inflammatory disease.

Of the ten cases of actual stenosis he considered five as of congenital origin, and, of the remaining five cases, two were due to "kinking of the ureter over anatomical structures," one over the uterine artery, and one over the vas deferens. Three were due to local contiguous inflammatory processes invading the ureteral walls secondarily. Apparently he did not consider the possibility of any of these contiguous inflammatory processes being due primarily to a distant focus of infection. "There was not a single case in which the

lesion required the hypothesis of blood borne infection for its complete explanation."

However, Schreiber's work demonstrated that clinicians and pathologists had been neglecting the ureter as an important source of ill health. "The finding of the above 12 cases in our unselected 100 consecutive autopsies suggests that the importance and incidence of hydroureteronephrosis have been generally underestimated; and that Hunner's emphasis of this condition is justified."

The author's opinion is that such pathologic studies on relatively small groups of cases should not be accepted as disproving the theory of focal infection origin of ureteral strictures, logically derived by Hunner from a very large clinical experience. However, the persistence of hydroureter and hydronephrosis, following correction of the supposedly causative pelvic lesions, in an appreciable proportion of the cases studied by Sturgis and the author[43] leads one to believe that the influence of these lesions upon the ureter over a considerable period of time, may have resulted in stricture formation which prevented involution such as was found to occur in other similar cases. Finally then, there seems evidence to the effect, that while focal infection is very probably the etiologic factor responsible for stricture of the ureter in many cases, particularly those in which no demonstrable pathologic process has ever existed in the pelvis, such lesions may be caused by a variety of other factors.

The symptoms of ureteral stricture, as has been frequently pointed out by Hunner, are of such protean character that they may frequently lead to diagnostic confusion. Their importance as a primary etiologic factor in hydronephrosis, pyonephrosis, pyelitis, pyelonephritis, urinary calculi, "so-called" essential hematuria, and possibly renal tuberculosis, have all been repeatedly emphasized by Hunner,[74,75,76,79,81,83,86,87,92,93,94] and in such conditions the symptoms are obviously those of the resulting lesions. There is a large group of cases, however, in which no such obvious secondary effects have resulted in the urinary tract, but in which strictures of the ureter are no less demonstrable by appropriate methods of examination. Among the symptoms which have been listed by Hunner,[77,82,89] as occurring in such cases are those related to the bladder such as frequency, urgency, dysuria, incontinence and enuresis; those related to the genital organs such as dysmenorrhea, dyspareunia, a feeling of pelvic pressure or prolapse, and ovarian neuralgia; those related to the digestive tract such as anorexia, flatulence, painful defecation, and

feeling of rectal pressure; abdominal pain of less specific location, backache, and pain radiating into the thighs; and finally symptoms of a low grade toxemia such as headache and unexplained low grade fever. Many of these symptoms are those commonly complained of in functional neuroses, and when careful examination of the organs most prominently suggested by the symptoms of the individual patient have yielded negative findings, and the urine is negative and no prominent urinary symptoms have been mentioned, the patient is very apt to be assigned to this group without consideration of a possible urinary tract lesion. The complaints of many such patients are undoubtedly founded upon a functional basis, but in some, the later development of obvious more serious urinary tract lesions reveals that an organic basis for the complaints has existed, which might have been relieved had it been discovered and treated.

The diagnosis is dependent upon a careful analysis of symptoms, careful physical examination and cystoscopic study. Any of the symptoms listed above should suggest a thorough search for stricture unless some other obvious cause is discovered. In examination of the abdomen tenderness over the kidneys anteriorly or in the costovertebral angles usually can be elicited. Palpation over the ureters as they cross the pelvic brim usually will reveal tenderness with reproduction of some of the patient's most prominent symptoms. If bladder irritability has been a symptom, a desire to void is particularly apt to be produced by such palpation. On vaginal examination tenderness over the ureters in their lower broad ligament portions, as they encircle the cervix to enter the bladder wall, is apt to be even more marked than at the pelvic brim, and the reproduction of symptoms by palpation in this region is even more striking.

On cystoscopic examination if the urine is infected there is apt to be evidence of a chronic cystitis and especially a chronic trigonitis. If the urine is uninfected but strictures are present, there often will be found a small zone of reddened mucosa surrounding each ureteral orifice. The ureters should be catheterized one at a time with two or more days intervening, usually using for the first time a 7 F. catheter, upon which a fusiform bulb of bees wax, with gently sloping shoulders and maximum diameter of 10 or 11 F. has been molded about 10 cm. back of the tip. If stricture is present, the tip of the catheter occasionally and the bulb practically always will encounter resistance in passing through the stricture area. Hunner has stressed the point, however, that such resistance on introduction of the catheter does

not necessarily indicate stricture, as it may result from a fold of the ureteral wall pushed ahead of the catheter tip or bulb, or from temporary ureteral spasm, but that a "hang" of the bulb on withdrawing the catheter practically always indicates stricture. It should be emphasized here that the easy passage of a catheter with no bulb does not eliminate the possibility of stricture. Everyone who is familiar with the technic of this method has encountered cases in which the first 10 cm. of a 7 F. catheter passed easily through a stricture area, which when encountered by the bulb was found to be so dense and so tight that the bulb was molded into a thin film of wax extending 10 cm. or more along the catheter. Pyeloureterograms in most instances will show some dilatation of the renal pelvis and of the ureter above the point of stricture, but Hunner has emphasized the fact that in some cases, particularly the earlier ones with an active ureteritis, the renval pelvis may be smaller than normal. This is probably best explained on the basis of reflex contraction of the pelvic and ureteral walls, as a result of the painful nature of the inflammatory process in the strictured area. In such cases it is obvious that an accurate diagnosis can be made only by the use of catheters with bulbs, although if a pyeloureterogram is taken with the catheter entirely withdrawn from the ureter, a filling defect usually will be noted at the site of the stricture.

Treatment should consist of general measures to improve the health of the patient, with particular attention to elimination of any foci of infection and ureteral dilatations. The dilatations should be accomplished by the repeated passage of catheters upon which bulbs of increasing size have been molded. An interval of ten days to two weeks should be allowed to elapse between treatment of the same ureter, and the diameter of the bulb should never be increased more than 0.6 mm. at a time, and in cases with dense strictures no more than 0.3 mm. In those cases with strictures so dense as to mold the wax bulbs ureteral dilating bougies may be used to advantage. In patients who react to the treatments with an exceptional amount of pain, or show a tendency to ureteral spasm which interferes with the passage of the catheter and bulb, a small catheter may be passed first, through which a few cc. of a 1 to 500 solution of nupercaine (Ciba) may be injected and retained for fifteen minutes before passing the bulb or bougie.

No more forceful proof of the importance of the recognition and adequate treatment of ureteral strictures, as well as other causes of

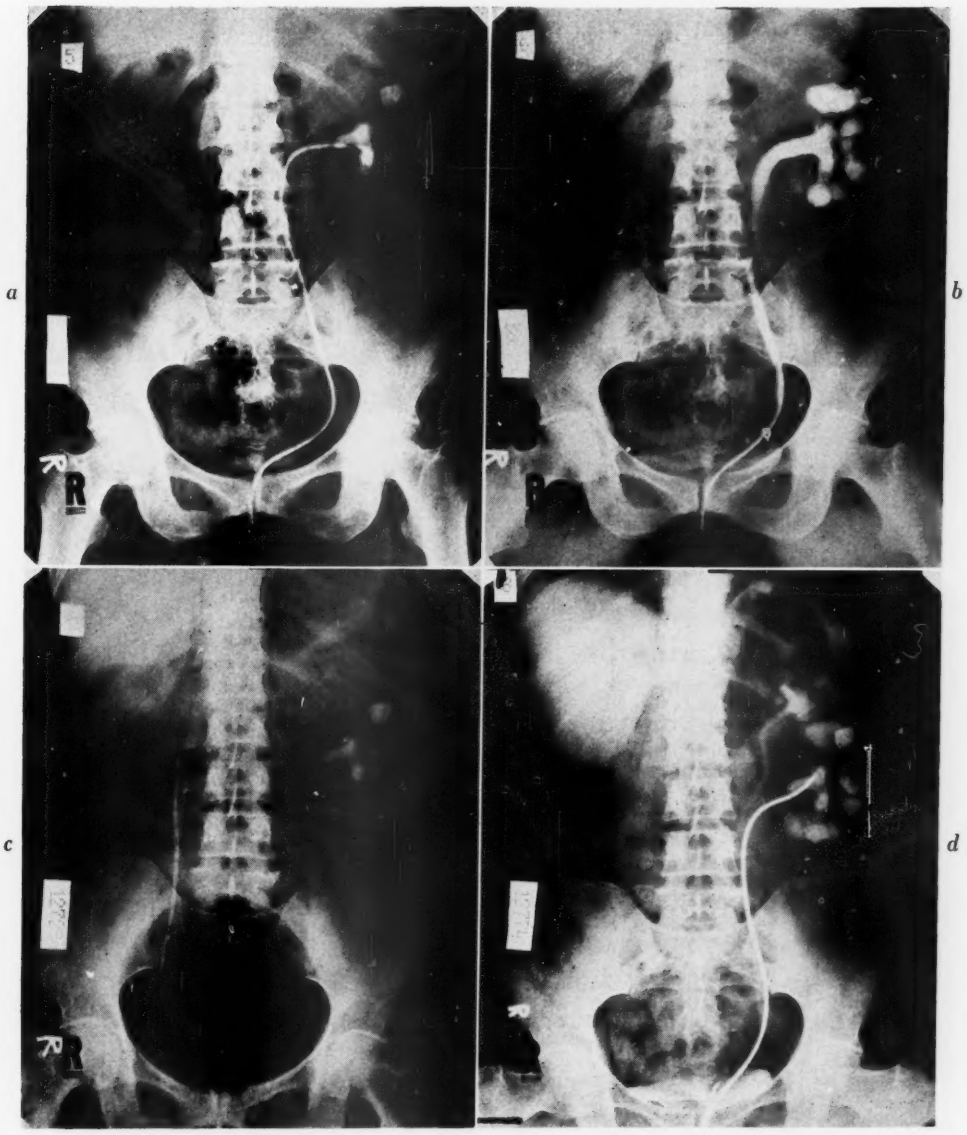


FIG. 51. Illustrating a case who had suffered from persistent pyuria and intermittent "cystitis" symptoms for twenty years before urologic examination was done. This examination showed stricture of the right ureter with functionless right kidney, intravenous pyelograms (*c*); multiple calculi (*a*) and a heavy proteus infection in the lower segment of a double left pelvis; multiple strictures in the ureter leading from this pelvis (*b*) and stricture of the ureter leading from the upper segment of the left pelvis (*d*) which was uninfected and the only portion of the patient's renal substance which was functioning normally. (From Everett, H. S. *J. Urol.*, 36: 1, 1936.)

ureteral obstruction need be mentioned than the highly satisfactory results obtained by a systematic conscientious pursuit of this routine. These results have been most frequently emphasized by Hunner, but have also been experienced and reported from time to time by many others who have followed his teachings. In the realm of major pathologic lesions it is the general experience that chemotherapy or pelvic lavage is apt to be of little use in rendering the urine permanently sterile, so long as any obstruction to its free outflow exists. On the other hand many cases, with long standing infection and serious impairment of renal function have had the urine rendered sterile, and the function restored to normal with a complete restoration of health by the establishment of adequate drainage alone. In some cases of long standing all symptoms may be relieved and the urine become free of pus but continue to show organisms on culture. In such cases the more efficient recently discovered chemotherapeutic drugs such as mandellic acid, sulfanilamide or sulfathiazole may succeed in finally rendering the urine sterile if administered after adequate drainage has been established. In a long and otherwise excellent monograph on pyelonephritis Weis and Parker[217] have completely ignored the therapy of these conditions from the point of view of relieving urinary stasis. As a result all of their patients progressed rapidly to a fatal termination. On the other hand, Longcope[141,142] who has recognized the importance of drainage in these cases and has had his patients treated with this in mind, has reported several instances of patients first seen in an advanced stage of the disease with contracted kidneys, greatly diminished function, and hypertension, in whom the progress of the condition has been arrested and the patients maintained in a state of relatively satisfactory health over a period of several years. In cases of early renal tuberculosis Hunner[93] has been able to retard the progress of the disease so that there was little diminution in function and only slight changes in the pyelograms after two to three years. While he has not unqualifiedly recommended such treatment in cases of unilateral tuberculosis, this discovery is of tremendous importance in consideration of the therapy of this condition when there is bilateral involvement.

In patients with renal or ureteral calculi[76,81,83,87,94] it has been the practice in Hunner's clinic for a number of years to dilate thoroughly both ureters before operating for removal of the calculi. This practice has resulted in materially shortening the period of drainage from the

pyelotomy, nephrostomy or ureterostomy wounds, and more important still in a considerable reduction in the incidence of recurring stones. In cases with essential hematuria[79,92] the bleeding can usually be relieved by thorough dilatation of the ureters. Of twenty-seven such cases reported by Hunner[92] there were only three in whom operation was found necessary, although in all of them there was gross hematuria and in many the bleeding was profuse. In only one instance was it necessary to remove the kidney.

In regard to the less specific conditions, it is a common experience to encounter patients who have suffered for years from some combination of the symptoms enumerated above, and who have been subjected to various forms of therapy, in many instances including one or more major operations, without relief, who are promptly relieved and restored to health upon the discovery and adequate treatment of ureteral strictures. It seems, however, that a word of warning is appropriate here, namely that it is unwise to ignore the existence of such conditions as functional neuroses. There are undoubtedly certain individuals who "enjoy poor health" and who bask in the warmth of the ministrations of physicians and the sympathies of their families and friends. To avoid catering to the whims of this class, even though ureteral strictures may be demonstrated, if the renal function is normal and the urine is uninfected and an adequate series of ureteral dilatations fail to achieve symptomatic relief, the treatment should not be persisted in further, but the aid of psychiatric consultation and therapy should be sought.

3. *The Urinary Tract in Pregnancy.* Anatomic, physiologic and pathologic changes in the urinary tract occurring during pregnancy and the puerperium have been the subject of much interesting investigation, as well as some not too sound speculation, since 1843 when Cruveilhier[24] first described dilatation of the ureters as a frequent accompaniment of the gravid state. Such studies were of necessity limited to anatomic observations made at autopsy or during operations until the perfection of modern urologic, roentgenologic and bacteriologic technic made possible careful detailed studies upon living subjects. The advent of such technic, however, has given a tremendous impetus to such studies, and a wealth of data has accumulated which is not only of great scientific interest but also of invaluable practical importance. The results of much sound and valuable investigative work have been reported by Traut and his associates from the New York Hospital, and Hundley and his asso-

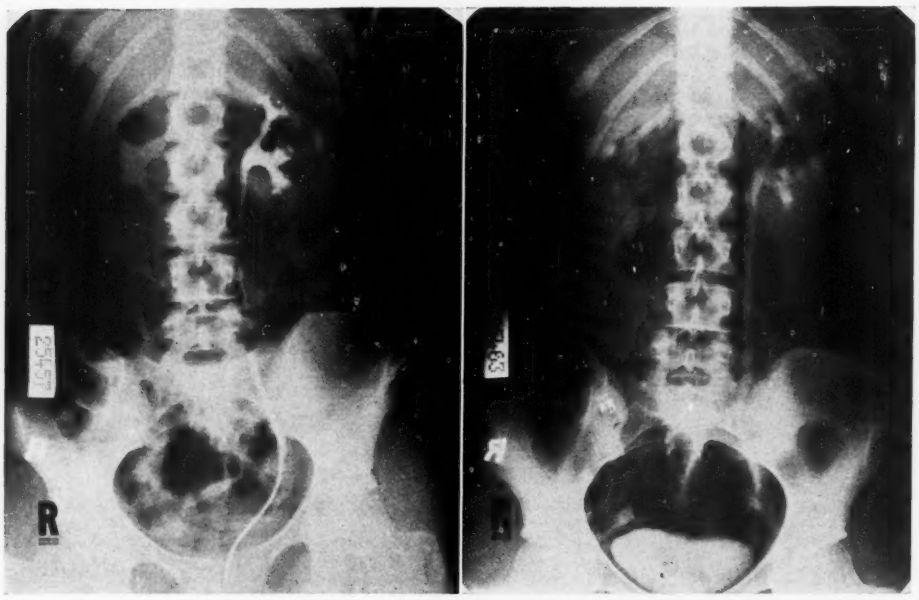
ciates from the University of Maryland, to mention specifically only two groups among many who have contributed much. In a recent brief but comprehensive review Traut and Kuder,[206] after eliminating many reports of a confirmatory nature, still have appended a bibliography consisting of 330 references, and the reader desiring such a review is referred to their report. Although this is one of the most important phases of urology peculiar to the female, our remarks must be confined to a summary of the present status of our knowledge. For this purpose the material which has emanated from the clinics of the two groups mentioned above will be extensively drawn upon, and the acknowledgement of this fact is hereby made.

a. Anatomic and Physiologic Considerations. The most widely recognized change that occurs in the urinary tract during pregnancy is a dilatation of the ureters and renal pelves. This was first observed in the course of anatomic studies, but more recently has been repeatedly demonstrated by urographic studies. This change is observed in over 80 per cent of all pregnant women (Traut) and has been demonstrated among others by Baird,[4] Kretschmer, Heaney, and Ockuly,[132] and Hundley and his associates.[65] The dilatation is usually more marked on the right side, and several causative factors for its production have been postulated. Among these factors should be mentioned first pressure from the pregnant uterus. Though such pressure is probably not the only factor concerned, there is much evidence to the effect that it is a very important if not the chief one. Among such evidence may be cited the fact that the ureters are rarely dilated below the pelvic brim, and that dilatation is rarely observed before the sixteenth week of pregnancy, when the uterus rises above the level of the pelvic brim. Similar dilatations have been observed in patients suffering from large pelvic tumors, either uterine fibroids or ovarian cysts. Hundley and his associates[65] studied a small group of such cases, which included uterine fibroids only, and came to the conclusion that a softening of the ureter which was observed in pregnancy and attributed to an hormonal effect, was probably an essential prerequisite to compression by the softer and less rigid pregnant uterus. In the series with tumors studied by Kretschmer and Kanter,[3] however, the incidence of ureteral dilatation in patients with large ovarian cysts was greater than in those with fibroids. The fact that the right tract is dilated more frequently and usually to a greater extent than the left, can be explained only on the basis of pressure. Any other effect, such as an hormonal one, should be dis-

tributed equally to the two sides, but the protective covering of the left ureter by the sigmoid, as well as the usual tendency toward dextrorotation of the uterus, renders the right ureter decidedly more subject to pressure as it crosses the pelvic brim. Lee and Mengert[137] found no diminution in the dilatation of the ureters and pelves after drainage through indwelling catheters for twenty-four hours, but Hundley and his associates[65] who repeated the experiments, leaving the catheters in place for forty-eight or seventy-two hours, found definite diminution in the size of the dilated tracts after these longer periods of drainage. Mengert[153] failed to find ureteral and pelvic dilatation in eight different species of four-footed animals, in which posture obviously would obviate pressure of the uterus upon the ureters.

Hofbauer,[62,63] and Hundley and his associates[65] observed an edema of the ureteral wall and an hypertrophy of the musculature, particularly that found in the periureteral sheath of Waldeyer encircling the juxtavesical portion of the ureter. Hofbauer believed that this hypertrophy of the sheath of Waldeyer was the chief causative factor of the ureteral dilatation; but such an explanation would require that the dilatation should be approximately equal on the two sides, and that it should extend into the pelvic portion of the ureter. Hundley has observed similar histologic changes in a woman dying of a ruptured ectopic pregnancy at the seventh week of gestation, and in a man dying of a teratoma of the testis containing much chorionic tissue, in neither of whom were the ureters dilated. Hundley and his associates have postulated the greatly increased amount of estrogenic hormone which is elaborated during pregnancy as responsible for these histologic changes, but the same authors in a small series of animal experiments were not able to reproduce the changes by administration of considerable quantities of this hormone. Brack and Langworthy[7] have demonstrated that the estrogenic hormone increases the tonicity of vesical muscle.

Traut and McLane,[207] and Traut, McLane, and Kuder[208] have conclusively demonstrated by the use of an apparatus devised by Trattner and called an hydrophorograph, that there is a loss of muscular tone and diminution of peristaltic activity in the ureter, beginning in the third month of pregnancy and increasing progressively until the two final months, when there is evidence of some regression of these hitherto progressive alterations. Coincident with the return of muscular irritability during the two final months of



a *b*

FIG. 52. The patient illustrated here, white, aged thirty-one, had suffered from severe dysmenorrhea since the onset of menstruation. The cervix had been dilated on two occasions and eight years before the appendix was removed, the uterus suspended, and the presacral plexus resected. None of these procedures have given relief from the dysmenorrhea, and for the past eight years she has suffered from attacks of severe pain in the right lower quadrant usually lasting for about ten days and occurring at intervals of two weeks to three months. For the past four years these attacks have been accompanied by severe nausea and vomiting. Her only pregnancy eight years ago was terminated at the third month because of pernicious vomiting. She has undergone several *x*-ray examinations of the gastrointestinal tract with negative findings. There have been no urinary symptoms and examination of the urine has never revealed any abnormality. Examination of the abdomen, however, showed marked tenderness of the ureters as they crossed the pelvic brim, and on vaginal examination tenderness was even more marked in the lower broad ligaments. The genital organs were normal to palpation. At cystoscopic examination February 5, 1941, the left ureter was catheterized with a No. 7 renal catheter, but on the right side a similar catheter could not be passed more than 3 cm. above the orifice. The left kidney excreted 35 per cent phenolsulfonphthalein in a half hour, but no dye was recovered from the right kidney through the bladder. The retrograde pyeloureterogram (*a*) of the left side would probably ordinarily be interpreted as normal, but careful inspection shows dilatation of the usually narrow portions of the ureter, so that it is about the same caliber throughout from the broad ligament region upward. Intravenous pyelograms (*b*) showed no visualization of the right pelvis until seventy minutes after injection of the dye. There is considerable retention of the dye in the left pelvis and ureter even after this interval and the last 3 cm. of ureter above the bladder are markedly narrowed.

gestation, these authors have also observed some diminution in the degree of dilatation of the pelves and ureters in the same subjects. This last observation has not been recorded by other investigators. The authors believe that "This diminished peristaltic activity of the ureters—cannot be explained on the basis of dilatation. On the contrary, dilatation of the ureters during pregnancy is probably in great part dependent upon the atony of the ureters." Again, if this were true, it may be reasoned that the dilatation should be more nearly equal on the two sides. Following delivery they have found that atony is again marked until the third week, after which motility returns rapidly to normal levels, which are usually attained during the sixth or seventh week postpartum. It also has been found that about the same length of time usually is required for complete disappearance of all dilatation of the upper tracts. The authors postulate a chemical or hormonal basis for the production of this atony, which they consider as similar to that occurring in the uterus under the same circumstances. They make no such statement, but it is generally considered that progesterone is responsible for uterine atony, and some recent work of Langworthy and Brack[134] has tended to show that the same substance is responsible for increase in capacity and decrease in tone of the bladders of rabbits during pregnancy. Muellner[159] in a recent cystometric study has shown that in the human the capacity of the bladder is increased and its tone diminished during pregnancy and the puerperium. These changes were also found to begin at the third month and increase progressively and to follow about the same time relationships as the similar changes in the ureter, except that no regression was noted in the two last months of gestation.

b. Bacteriologic Considerations. It has been frequently stated that pathogenic micro-organisms can be recovered from the bladder urine of a large proportion of normal pregnant women, and that the normal kidney can excrete micro-organisms with no impairment to itself or the other urinary organs. Recent carefully conducted bacteriologic studies, however, have tended to disprove at least the first part of this statement. Eighty to 90 per cent of the urinary tract inflammations occurring during pregnancy are caused by members of the coliform group of micro-organisms. McLane and Traut[150] recovered such organisms from the bladder urine in only 6.08 per cent of their examinations, representing 115 observations made on a group of thirty women, and from the kidney urine only once or 0.86

per cent. Hundley and his associates[66] in a similar study of fifty women recovered coliform organisms from the upper tract in 6 per cent and from the bladder in 9 per cent.

The route by which the offending organisms reach the upper urinary tracts in pyelitis and pyelonephritis, occurring in association with pregnancy and otherwise, has been the subject of much speculation and investigation. Without going into detailed discussion it may be said that three routes have been considered, namely: (1) from the bladder by reflux into the ureter and antiperistalsis of the ureter; (2) from the bladder, urethra, genital organs, or intestines through the blood stream; and (3) from the same sources through lymphatic conduction. While it is conceivable that infection through anyone of these routes may occur in certain instances, there seems to be least evidence in support of the first and most in support of the third as the usual route of invasion.

c. Pyelitis of Pregnancy: Etiology. With pelvic and ureteral dilatation and urinary stasis occurring in a large proportion of pregnant women, and the recovery of coliform organisms from the upper urinary tract at least occasionally in women showing no clinical evidence of an actual inflammatory reaction, some additional etiologic factors are necessary to explain the actual production of an inflammatory reaction in those patients in whom it occurs. The incidence as reported from different clinics varies widely as may be seen from the following table taken from Traut and Kuder with additions:

	Per Cent
Kiel Frauenklinik (Freudenberg)	1.8
Boston Lying-In Hospital (Crabtree)	2.1
New York Lying-In Hospital (Traut)	2.2
London, Guys Hospital (Gibberd)	1–2.0
London, University College Hospital (Dodds)	1.1
Glasgow Royal Infirmary (Baird)	14 to 16.0
New York (Pugh)	10.0
San Francisco (Emge)	7.0
Griefswald (Phillipp)	3.5
Montreal (Seng)	3.0
Vienna (Latzko) (Lepoutre)	7.0
Amsterdam (Van Rooy)	0.8
University of Maryland (Hundley)	3.1
Johns Hopkins Hospital (1939 and 1940 Hellman)	0.5

Among the contributing factors which may render the pregnant woman more susceptible to inflammatory disease of the urinary tract may be mentioned constipation with intestinal stasis, previous

inflammations of the urinary tract, particularly those which may have occurred in childhood or previous pregnancies, lesions of or involving the urinary tract which may tend to intensify or increase the stasis ordinarily encountered in pregnancy; and finally, with particular reference to those cases occurring during the puerperium, traumas occurring during delivery especially those which tend to interfere with the normal emptying of the bladder and necessitate repeated catheterization. The first of these factors, intestinal stasis, has been particularly emphasized by Traut,[204] who believes in the lymphogenous route of infection and that such stasis may result in larger quantities of coliform organisms reaching the urinary tract. Obstructive lesions of the urinary tract which tend to intensify the stasis, particularly ureteral stricture have been emphasized by Hunner.[84] As such lesions are apt to have been present and of primary etiologic importance in the production of any previous inflammatory disease of the urinary tract, which may be considered as contributing to an attack of pyelitis of pregnancy, their importance cannot be overemphasized. In a woman known to have suffered previously from a urinary tract infection who is contemplating marriage and pregnancy, thorough treatment of any discoverable obstructive lesions of the ureters may be of the greatest importance as a prophylactic measure. The care of patients suffering from urinary retention following operation or delivery has been discussed in a previous section.

Pathology. Traut and Kuder[206] after a careful consideration of the various terms used to designate the disease process under consideration, chose "pyeloureteritis" as the term most accurately descriptive of the process occurring in most cases. They believe that in most instances the inflammatory process is confined to the tissues of the renal pelvis and ureter, and that the term pyelonephritis should be limited to those severe cases in whom there is evidence of retention of nonprotein-nitrogen in the blood. This position does not seem entirely tenable. In the first place if the infection is unilateral, extensive parenchymal involvement and impairment of function may occur without nitrogenous retention because of the continuing normal excretory activity of the opposite kidney. In the second place the study of autopsy material from patients giving a history of "pyelitis" in the past, but dying subsequently of other causes, reveals that the kidney or kidneys practically always show evidence of some parenchymal involvement.

Symptoms and Diagnosis. Pyelitis or pyeloureteritis of pregnancy is usually thought of as an acute illness in which the patient suffers from chills with a high intermittent fever. During such

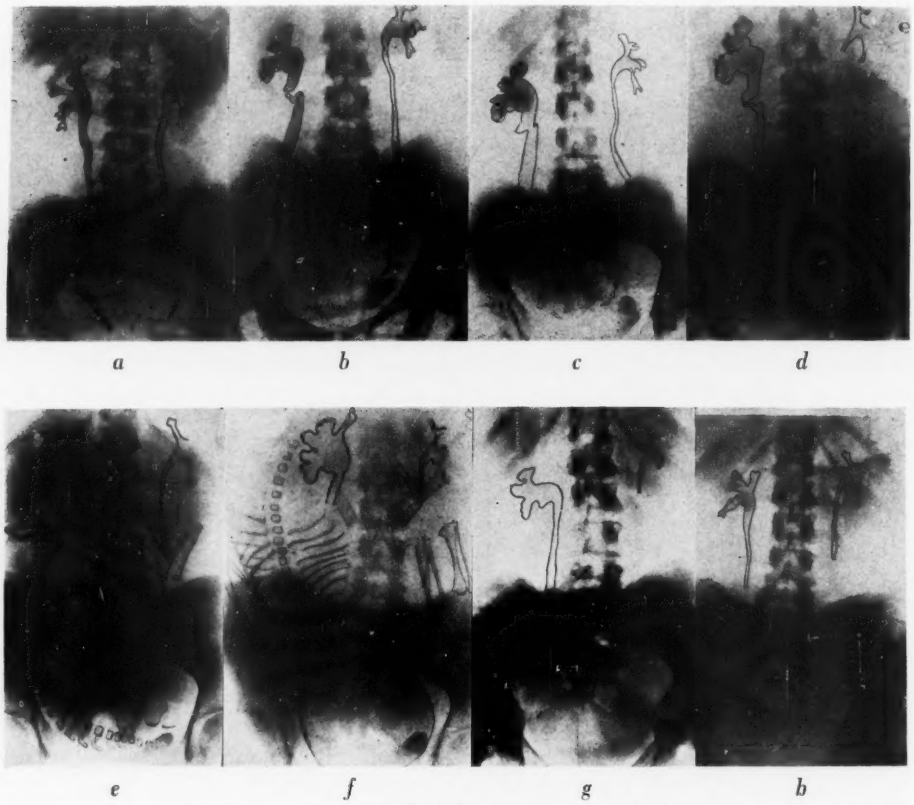


FIG. 53. Intravenous urograms (outlined for better reproduction) at various weeks of pregnancy and the puerperium: (*a*) 15 weeks, (*b*) 18 weeks, (*c*) 22 weeks, (*d*) 26 weeks, (*e*) 34 weeks, (*f*) 39 weeks, (*g*) 1 week postpartum, and (*h*) 6 weeks postpartum. All urograms except those shown in (*a*) are from the same patient. (From Hundley, J. M. et al. *Am. J. Obst. & Gynec.*, 30: 625, 1935.)

episodes the patient usually experiences general malaise with anorexia and often there is nausea and vomiting. Pain and tenderness are present both anteriorly and posteriorly over the kidney and along the course of the ureter, and frequent micturition with pain results from the cystitis which nearly always is also present. The condition is most frequently unilateral, the right tract being the one most often involved, though bilateral involvement and left-sided unilateral involvement occur not infrequently. Examination of the urine shows much pus with clumping of the cells and culture yields a heavy growth of organisms usually of the coliform type. During such acute

episodes the diagnosis usually should be quite evident, though the presence of digestive symptoms associated with right-sided abdominal pain and tenderness may at times suggest the possibility of acute appendicitis. The urine examination in such cases should serve to settle the question except in the rare instance of an acute appendicitis being accompanied by an acute pyelitis.

Traut and Kuder[206] have pointed out that emphasis has been placed largely upon such acute episodes, with neglect of chronic upper tract infections until their persistence eventually leads to such acute febrile illnesses. In order to detect such chronic phases of the disease, and thereby be in a better position to prevent the more serious acute episodes, serious attention should be given during the prenatal care of patients to any history suggesting a previous urinary tract infection, to the development of any symptoms suggesting a cystitis, and to the presence in the urine of any unusual amount of pus, particularly if there should be a tendency to clumping of the pus cells.

Prophylaxis and Treatment. Traut, Bayer, and McLane,[205] have given an excellent formula for the handling of obstetric patients during their antepartum care, in such a way as to reduce as far as possible the incidence of acute febrile "pyeloureteritis." They divide the patients into two groups; those who give no history of previous urinary tract infection, and those who do give such a history. The patients in the former group are questioned at each antepartum visit concerning such symptoms as frequency, dysuria and pain in the kidney region. If any of these symptoms are complained of, or if albumin is found in the urine without any other evidence of toxemia, a sterile catheterized specimen of urine is obtained for microscopic study and culture. If the culture proves to be positive for coliform organisms 0.3 Gm. of sulfanilamide are administered five times a day for five days and the fluid intake is limited to 1,500 cc. daily. As is always the case when administering sulfanilamide, an equal amount of sodium bicarbonate should be given. The patient returns after a week when the urine culture is repeated. If the second culture is positive, a complete urologic study is made including cystoscopy, ureteral catheterization with culture of the ureteral urines, differential kidney function tests and pyelograms. Even if the second culture is negative, the course of sulfanilamide is repeated after one week's rest, until a series of three negative urine cultures are obtained. The urine is then cultured once a month until delivery and

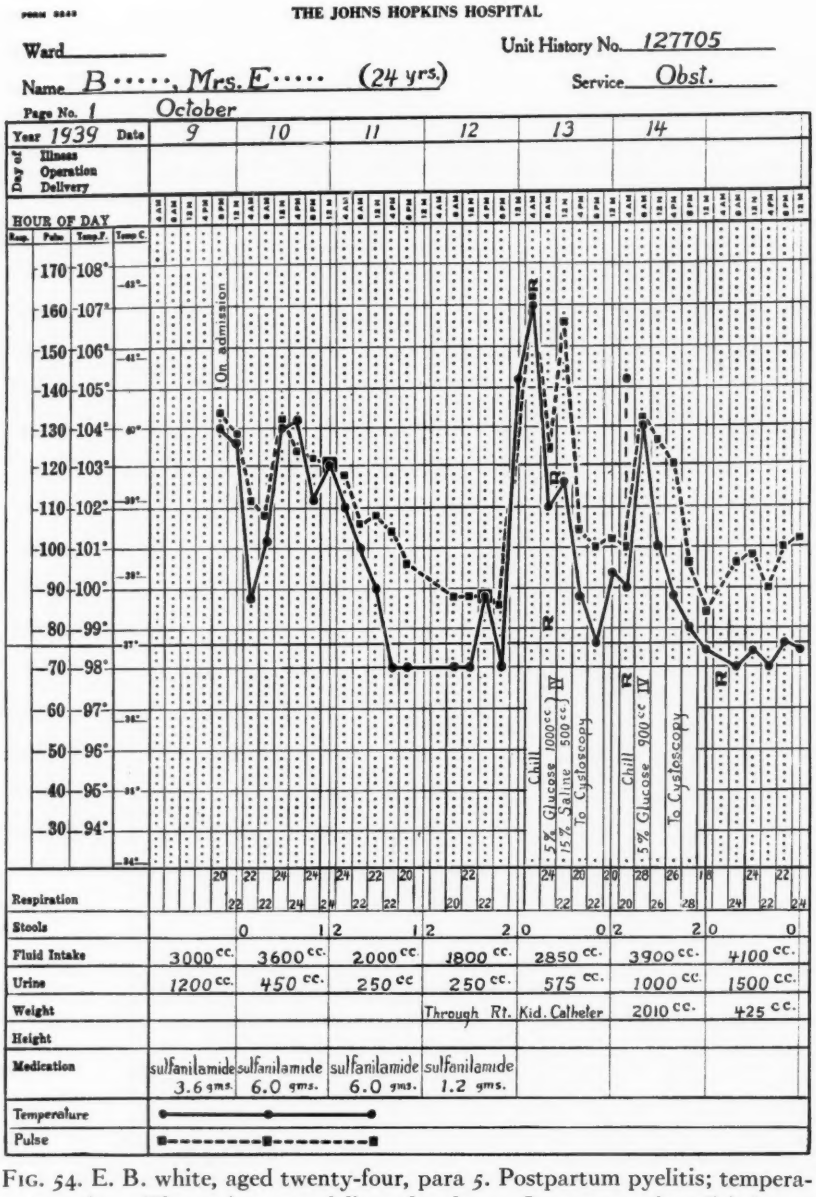


FIG. 54. E. B. white, aged twenty-four, para 5. Postpartum pyelitis; temperature chart. The patient was delivered at home. Symptoms of pyelitis began on the sixth day after delivery and became severe on the sixteenth day when she was admitted. Sulfanilamide therapy at first seemed effective but a short afebrile period was followed by fever which reached 107°F. Sulfanilamide was then stopped in the belief that the fever may have resulted from the drug. On the following day an inlying catheter was inserted to the right kidney. Thick purulent urine drained through the catheter which was left in place and irrigated for six days. Following insertion of the catheter, the fever quickly subsided and sulfanilamide therapy was resumed. Two weeks after the acute symptoms had subsided complete urologic investigation was made with results shown in Figure 55.

the above treatment repeated should a positive culture again be obtained.

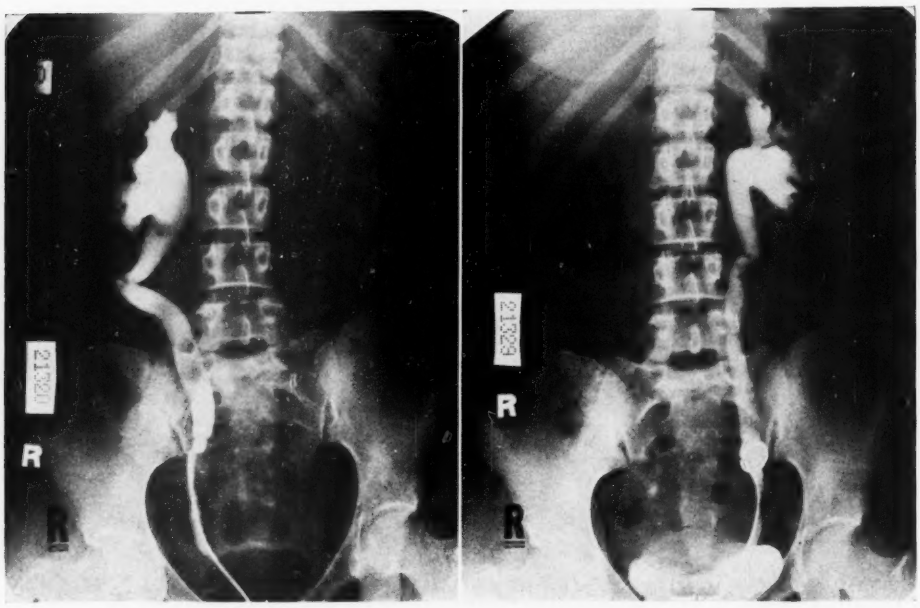
This routine would seem adequate, and in the hands of its authors has contributed toward reducing the incidence of febrile attacks of pyelitis in their clinic by 50 per cent. With such small doses of sulfanilamide the authors reported an incidence of unfavorable reactions of only 1 per cent. Nevertheless, the most recent trend is to substitute sulfathizole which has proved to be equally effective and much less apt to produce toxic reactions or unpleasant symptoms.

In the group from whom a history of previous urinary infection is elicited every effort is made to obtain accurate data concerning this infection and urine is cultured at the first visit. If the culture is negative it is repeated at each antepartum visit, during the puerperium, and twice after discharge. If the culture is positive, a complete urologic study is carried out at once and the patient is placed on ambulatory sulfanilamide therapy as outlined for the former group. She is seen at biweekly intervals until the completion of her pregnancy, unless an acute episode intervenes.

These regimes may be said to be excellent from the obstetrical point of view. From the urologic point of view, however, it is noteworthy that no mention is made of urologic treatment, other than chemotherapy, in those patients in whom the urologic studies reveal abnormalities such as obstructive lesions in the ureters. It is generally conceded that the presence of such lesions greatly reduces the effectiveness of even such efficient chemotherapeutic agents as sulfanilamide and sulfathiazole. The correction of such lesions when found by adequate dilatations of the ureter, therefore, can greatly enhance the value and effectiveness of chemotherapeutic measures. Such treatments are often somewhat difficult to carry out in the later months of pregnancy, and provided the patient is responding adequately to medicinal therapy they may be deferred until after the puerperium. If, however, chronic inactive infection in association with a lesion of this type should be discovered in the earlier months of gestation, thorough urologic treatment at this time affords additional protection against acute febrile attacks during the later months. During the past two years similar chemotherapeutic measures as those suggested by Traut, Bayer, and McLane have been carried out on the Obstetric Service at the Johns Hopkins Hospital, but in addition active urologic treatment under the direction of the author also has been resorted to when indicated. The

incidence of acute febrile attacks on this service during this time has been only 0.5 per cent.

The rôle of the urologist in the prophylaxis and treatment of



a *b*

FIG. 55. Postpartum pyelitis: (*a*) right, and (*b*) left pyeloureterograms. Note the marked dilatation of the pelves and of the ureters above the pelvic brim and the narrowing of their broad ligament portions. Wax bulbs hung firmly in the lower ureters on both sides. There was a calculus 15 mm. in diameter in the right ureter at the point of angulation. It appears in the plate (*a*) as an area of decreased opacity; in plate (*b*) made two days later it has descended into the pelvic ureter. A week later the calculus was removed by ureterotomy and the lower end of the right ureter was thoroughly dilated. Seventeen days later tubal sterilization was done, and the patient has been followed with repeated ureteral dilatations. The urine has become sterile and the renal function has returned to normal.

pyelitis of pregnancy antedates conception and continues long after delivery and the puerperium. Indeed it may be said to begin often in the childhood of the patient. Doubtless many of the previous urinary infections referred to by Traut, Bayer, and McLane occurred in childhood. In a study of thirty patients who had experienced one or more acute attacks of pyelitis during childhood, Wharton, Gray, and Guild[218] found urologic abnormalities in 57 per cent. Urine cultures were positive in 50 per cent, although an average of 9.6 years had elapsed since the last attack of acute pyelitis. In only two of the thirty patients, however, was there any persistence of symptoms, a fact which probably had led the patients in some instances

to discontinue urologic observation and treatment before every effort had been made to restore the urinary tract to a condition as nearly normal as possible.

In the case of a young girl or woman who has suffered a urinary infection, and in whom there is possibility of future pregnancy, frequent urologic observation and treatment, with particular attention to elimination of obstructive lesions, should be continued until the urine has become and remained sterile for at least two years before a pregnancy should be contemplated with equanimity. In those patients in whom the urine cultures remain positive in spite of all forms of treatment, and particularly if there is evidence of reduction in renal function, the condition should be considered as chronic pyelonephritis and the patients advised positively against pregnancy.

In the treatment of the acute attacks sulfanilamide and sulfathiazole have proved most effective. It was formerly considered that it was impossible to sterilize the urine in these cases until after the termination of pregnancy. With the use of sulfanilamide, however, Traut, Bayer and McLane[205] achieved this result in 55 per cent of their patients, and reduced the average duration of the febrile phase from 10.4 days to 5.4 days. They used the drug in large doses, 6 to 8 Gm. daily for the first two days, and sufficient thereafter to maintain a blood concentration of 8 to 10 mg. per cent and a urine concentration of more than 100 mg. per cent. Recent reports (Alyea and Roberts,[3] Cook[22]) although not dealing with pyelitis of pregnancy, seem to indicate that equally satisfactory results might be obtained with smaller doses. If the condition is unilateral and chemotherapy fails to relieve it, sufficient drainage may often be obtained by the introduction of an inlying ureteral catheter for a few days, during which time the chemotherapeutic drug may act more effectively. If the ureter is strictured and the acute phase can be relieved either by drugs alone, or by drugs administered while an inlying catheter is in place, subsequent dilatations of the stricture will materially reduce the probability of recurrence of acute symptoms.

If the acute symptoms fail to respond to any of the above forms of treatment, and particularly if evidences of retention of nitrogenous material in the blood begin to appear, the pregnancy should be terminated without delay. Bilateral involvement and secondary invasion of the urinary tracts by organisms other than the coliform group greatly increase the probability of the necessity of such an

eventuality. Nephrostomy as a procedure which may prolong the pregnancy sufficiently to permit the delivery of a viable child, and at the same time relieve the condition of the mother, has been recommended (Phaneuf and Graves,[169] Graves and Buddington[57]). Although we have had no experience with this method, our experience with nephrostomy in gravely ill patients with ureteral obstruction from other causes has been sufficiently satisfactory to make us feel that it is worthy of serious consideration in this group also.

VIII. CONCLUSION

An effort has been made to set forth herein most of the conditions of the urinary tract which are peculiar to the female, and to point out the important and close relationship that exists between many of these conditions and the specialities of gynecology and obstetrics. It is our firm conviction that a modern Woman's Clinic cannot be conducted to the best advantage unless there is constantly available the services of a competent urologist. In our own clinic from its beginning the urologic work has been handled by the members of our own staff, all of whom are thoroughly trained in the Kelly method of cystoscopy and in the general principles and technic of urologic surgery. We are convinced that the Kelly technic of cystoscopy for women affords many advantages over the technic available to those only familiar with the Nitze type of instrument. We are further convinced that a more complete and composite picture of the anatomic, physiologic and pathologic entities occurring in the genito-urinary systems of women can be obtained by gynecologists and obstetricians who are trained to conduct their own urologic investigations and treatments, than is available to those who find themselves under the necessity of calling to their assistance urologists, whose primary interest often centers upon the fields of prostatic and renal surgery.

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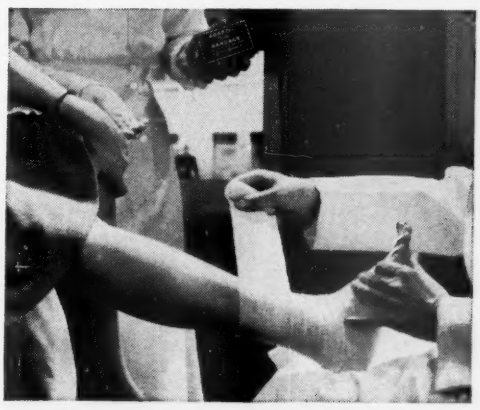

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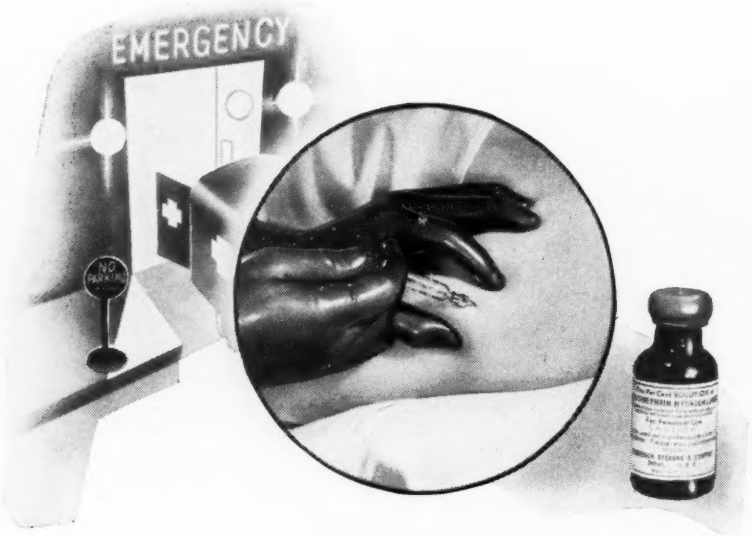

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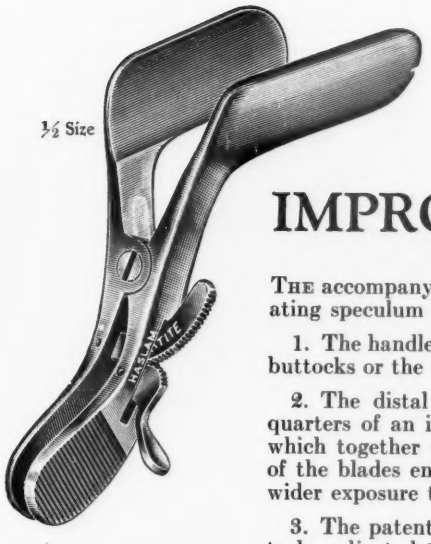

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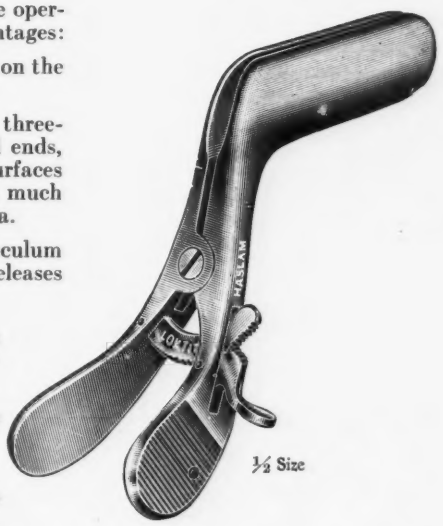

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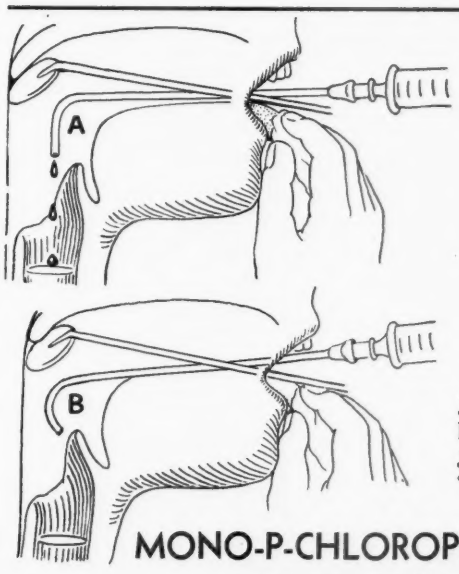

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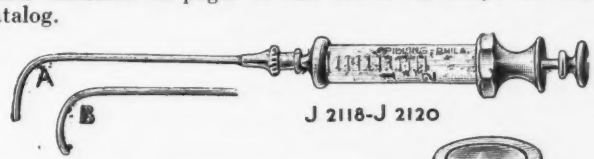

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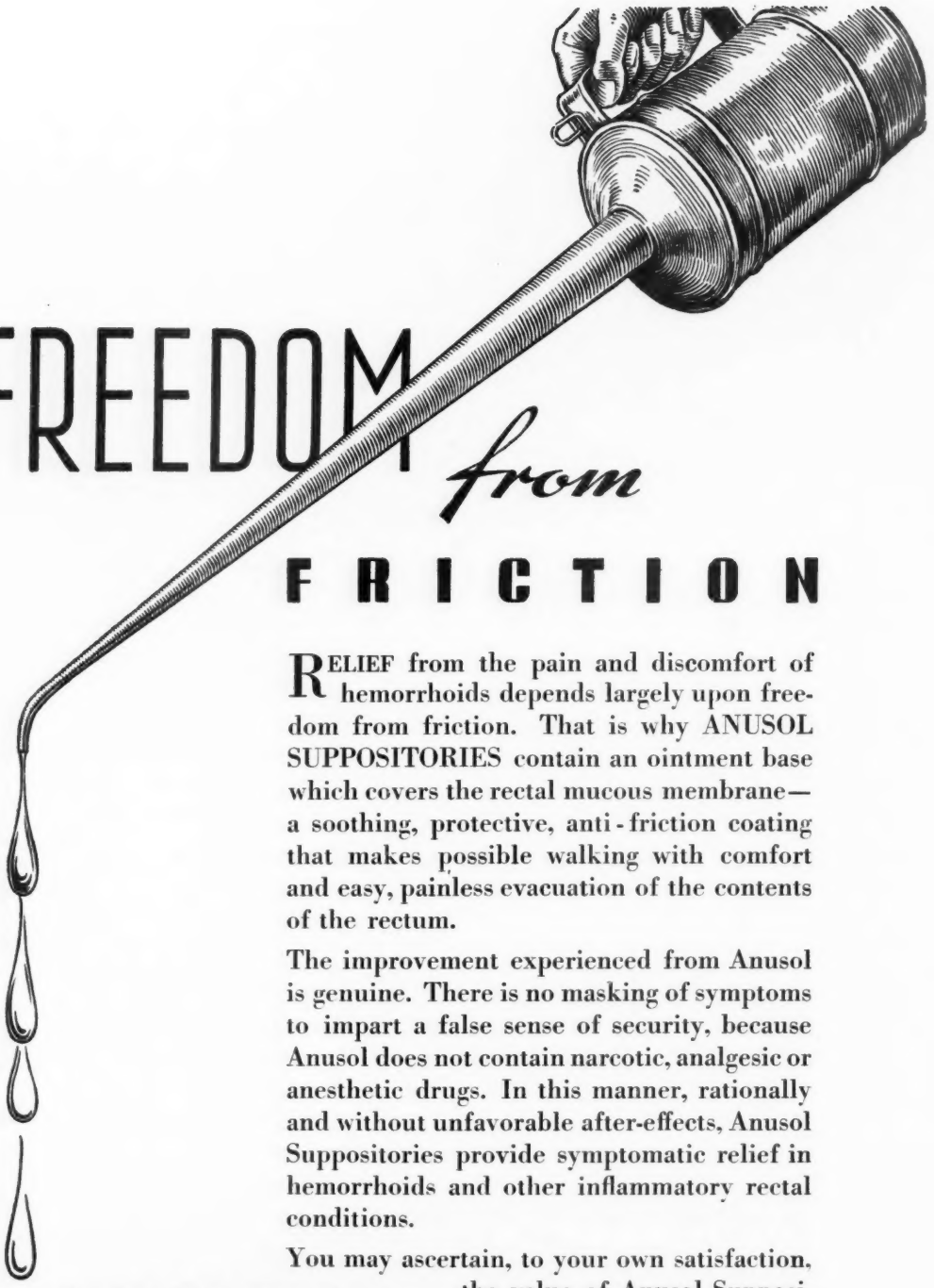

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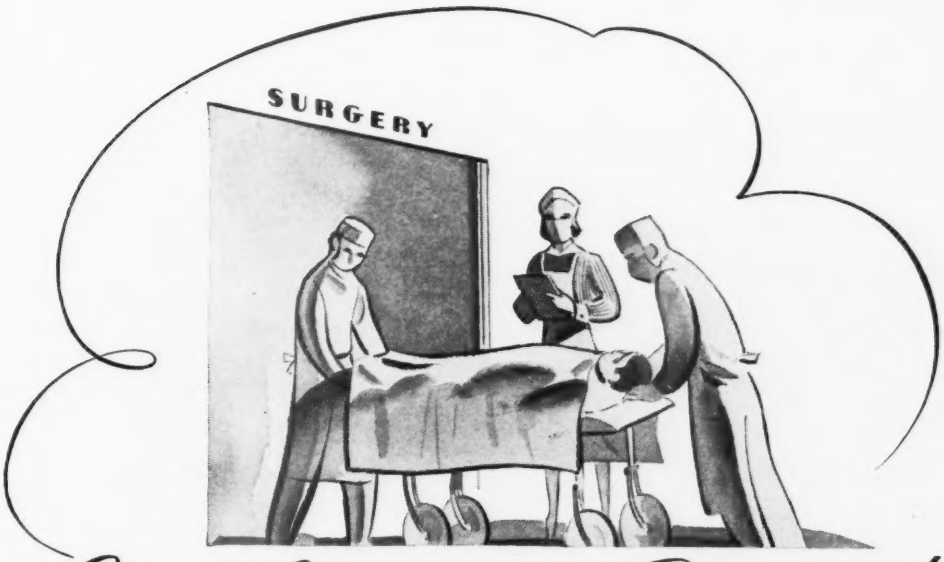

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Boston, May 12–14, 1941. (Secretary—DR. W. BLAIR MOSSER, Kane, Penna.)

AMERICAN ASSOCIATION FOR THE SURGERY OF TRAUMA

Seigniory Club, Montreal, Que., May 29–31, 1941. (Secretary—DR. RALPH G. CAROTHERS, 409 Broadway, Cincinnati)

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Hot Springs, Va., May 29–31, 1941. (Secretary—DR. CHARLES C. HIGGINS, 2020 East 93rd Street, Cleveland)

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AMERICAN COLLEGE OF SURGEONS

Boston, November 3–7, 1941. (Secretary—DR. FREDERIC A. BESLEY, 215 N. Sheridan Rd., Waukegan, Ill.)

AMERICAN CONGRESS OF PHYSICAL THERAPY

Washington, D. C., September 1–5, 1941. (Secretary—DR. RICHARD KOVACS, 2 East 88th Street, New York)

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Colorado Springs, May 26–28, 1941. (Secretary—DR. RICHARD W. TELINDE, Johns Hopkins Hospital, Baltimore)

AMERICAN MEDICAL ASSOCIATION

Cleveland, June 2–6, 1941. (Secretary—DR. OLIN WEST, 535 N. Dearborn Street, Chicago)

AMERICAN ORTHOPAEDIC ASSOCIATION

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Louisville, Ky., October 29–November 1, 1941 (Secretary—COL. JAMES M. PHALEN, 1870 Wyoming Ave., N.W., Washington, D. C.)

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Boston, November 3–7, 1941. (Secretary—DR. E. KLAUS, 1699 W. 25th Street, Cleveland)

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NEW ENGLAND SURGICAL SOCIETY

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Honolulu, 1942. (Secretary—DR. FORREST J. PINKERTON, Young Bldg., Honolulu)

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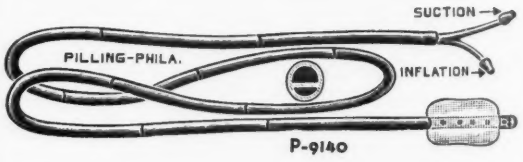

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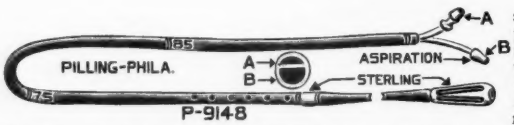

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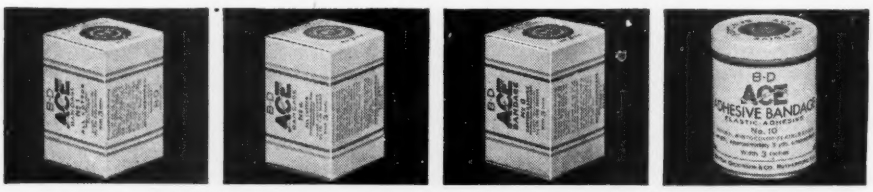

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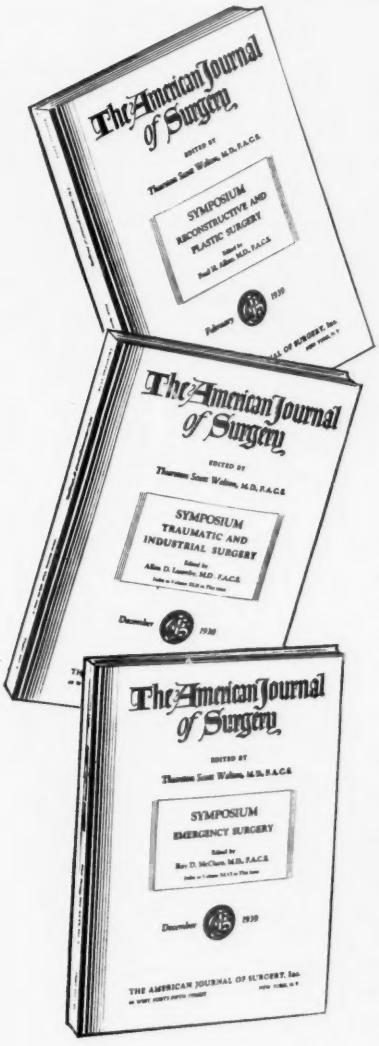

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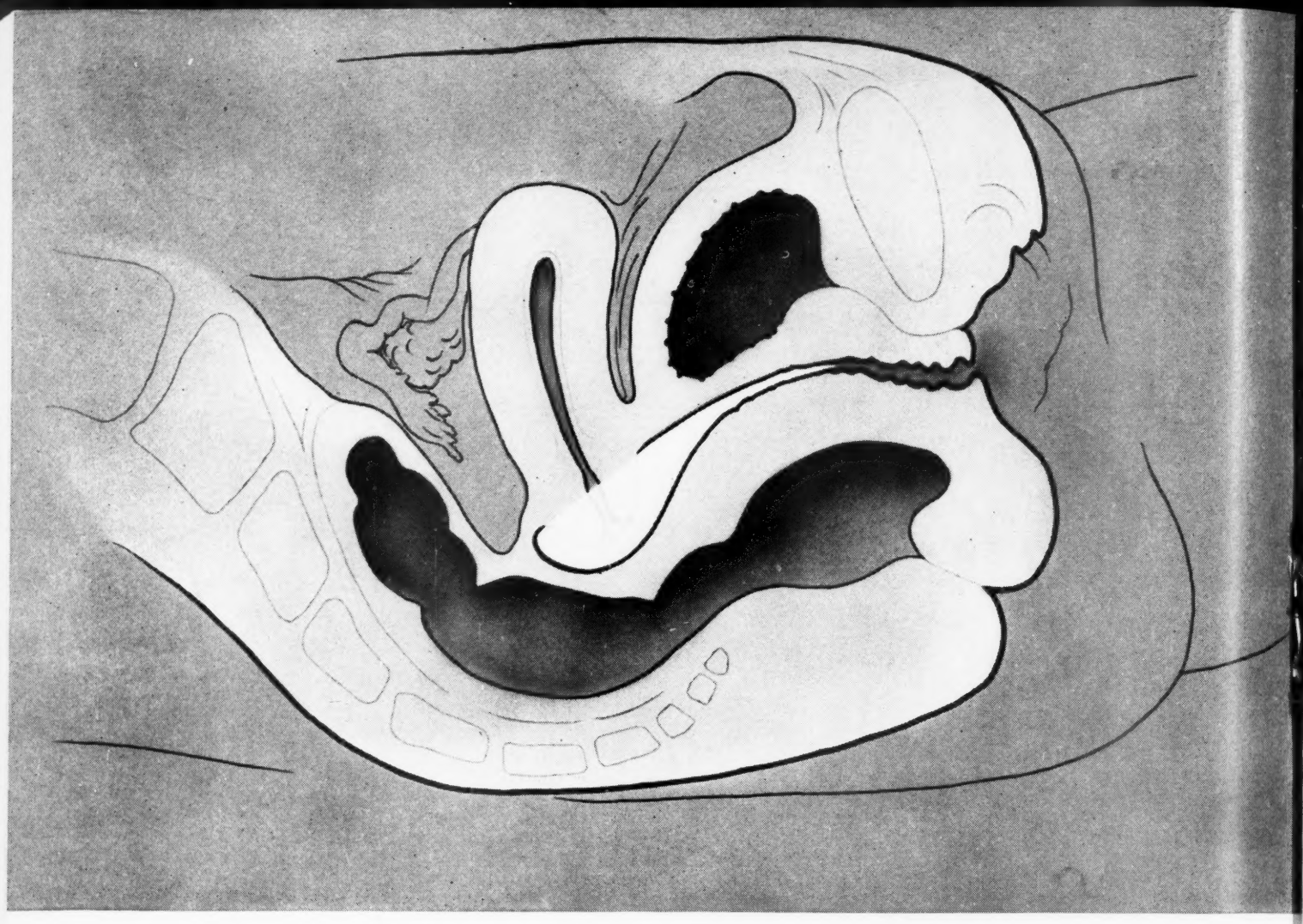

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The American Journal of Surgery

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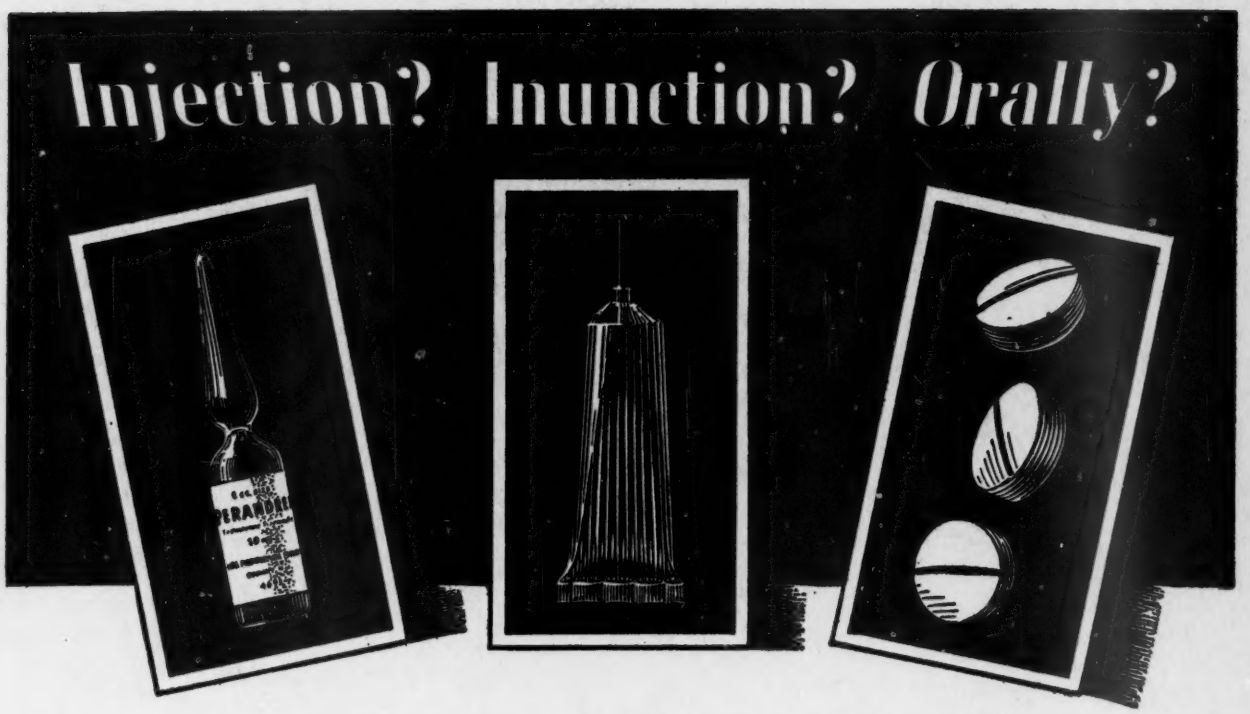

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